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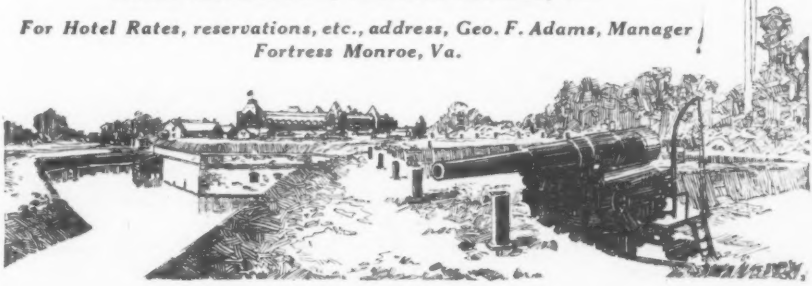

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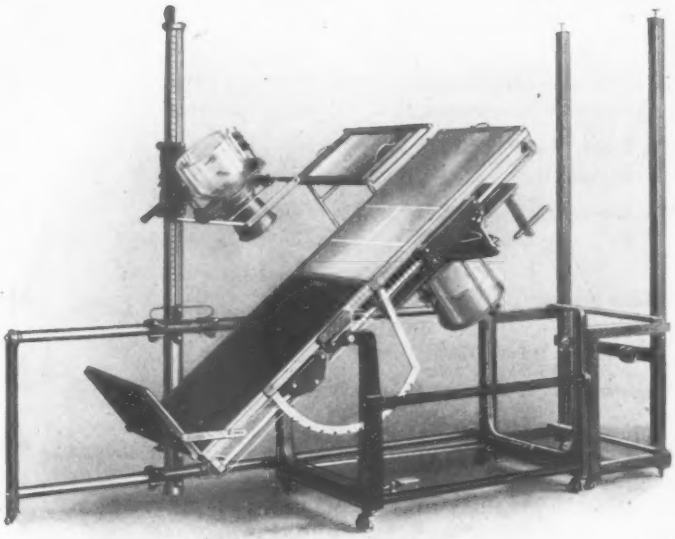

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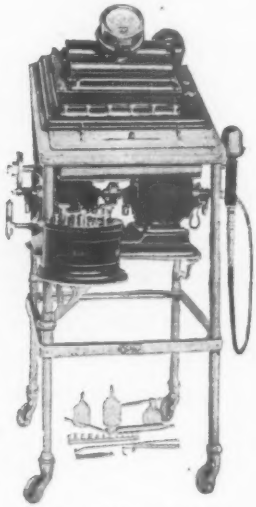

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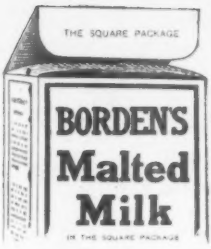

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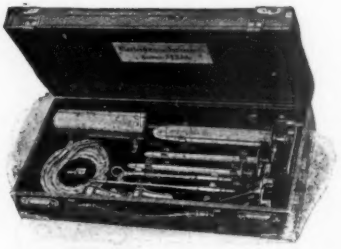

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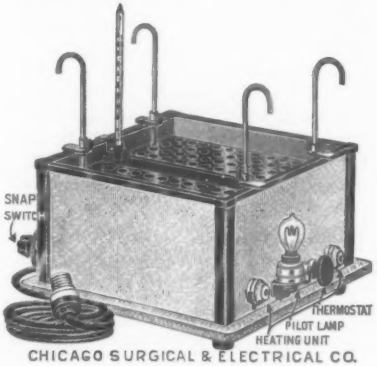

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ORIGINAL ARTICLES

SURGICAL SHOCK AND SOME RELATED PROBLEMS.[1]

By J. E. Sweet, A.M., M.D., F.A.C.S.,

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The subject of surgical shock has always been of deep interest to me, not alone because it is one of the unsolved problems of surgery, but because it affords to my mind such a striking example of one of the weak points in our present system of medical teaching. I mean the tendency to dislocate physiology from clinical medicine, the tendency to look upon physiology as a preparation for and not a part of. If the study of shock has taught anything, it is that the subject must be approached either by the physiologist who knows his clinical medicine or by the clinician who knows his physiology, and that physiology must be taught and learned more as a factor of the every-day practice of medicine and surgery. Anatomy is the foundation-stone of disturbed form. Pathology is in small part anatomy gone wrong; in major part it is only physiology gone wrong.

Therefore I like to talk of shock if for nothing else than to discourage the would-be surgeon. The greatest problem of modern surgery is how to make better surgeons. We may well begin by holding up before the youthful aspirants—every medical student more or less seriously contemplates the surgical career, the one and only ideal—a surgeon must know as much as any man in any branch of medicine.

[1] Read before the Medical and Chirurgical Faculty of Maryland, Baltimore, Maryland.

The first and chief trouble with the shock problem lies in the fact that we have no good definition. Shock is defined as a bleeding to death in the venous system of the body, that is, that in shock the blood collects in the veins, chiefly of the splanchnic system, and the patient dies because the blood fails to reach the right heart. But this disposition of the blood in shock is but a symptom, and but a symptom common to many other conditions which are not shock. It is like defining malaria as a febrile disease, characterized by regular remissions and exacerbations of temperature. Now that is what the malarial parasite does to the body, as it follows out its life cycle, but the fever is not malaria, nor is the peculiar wave-like fever malaria. The infection with this certain bug is malaria. So a definition of shock, as a bleeding to death in the veins, is only a definition of a symptom, not of a cause. A more accurate definition is, however, impossible, since we do not know the cause, therefore the next necessary step is to define and limit the definition, with the consequent result that inaccuracies, misstatements and confusions reign.

Let us agree that shock has something to do with blood-pressure and consider for a moment what blood-pressure is:

Three elements are united in the expression "blood-pressure:"

1. The pressure due to the specific gravity of the fluid itself—hydrostatic pressure.

2. The pressure caused by force exerted upon this fluid by the vessel walls and other external factors, the fluid being contained in a closed system of elastic tubes—hydraulic pressure.

3. The pressure due to movements of the fluid itself—hydrodynamic pressure.

Of these three elements the third, hydrodynamic pressure, hardly enters into a consideration of what is ordinarily included under the term blood-pressure. It is of importance in the study of certain manifestations of the transmission of pressure, such as the study of the pulse wave, but for our present purpose this hydrodynamic pressure can be left aside.

A consideration of the hydrostatic pressure of the blood leads us at once to a realization of the complexity of the factors which govern the pressure of the fluid within the blood-vascular system. It is evident that the pressure of every layer of blood must be increased by the weight of that amount of blood which lies in a vertical direction upon it, that is, considering now only the purely physical conditions and leaving all the other factors out of account. Thus the pressure of the blood in the arteries of the adult foot must be increased by the weight of a column of 165 cm. of blood (equal to 13 cm. of mercury), entirely apart from all other factors. The hydrostatic pressure in the veins of the foot and the leg is of surgical interest in the consideration of varicose veins and varicose ulcers, because varicosities are a question of hydrostatics, plus,

of course, some abnormal quality in the vein which makes them susceptible to this factor. A person with varicose veins finds relief on raising the foot to the level of the body. The varicosities appear chiefly in the veins of the subcutaneous tissue, where the veins have only the external support of this tissue. Therefore we can surgically treat and cure the condition by simply ligating these subcutaneous veins, thus forcing the blood to return by the deeper veins which lie in and beneath the muscles, and whose thin walls are strengthened by the structures which surround them on all sides.

Now normally this hydrostatic pressure is of little practical importance, since compensating devices are so well in hand, but in abnormal conditions surgery has often to think of pure hydrostatic pressure. One of the most instructive examples of the effect of hydrostatic pressure acting alone is the experiment of Hill and Barnard. If a tame rabbit be held in the vertical, head-up position, the blood will collect in the lower areas, especially the splanchnic area, and in a comparatively short time so much of the blood of the body may accumulate in this area as to cause the death of the animal from anemia of the brain. The rabbit has bled to death into the vessels of its own splanchnic area, yet we can hardly say it died of shock, for if we did our definition of shock would therefore have to be, shock is a lack of tone of the anterior belly wall; because if the experiment be tried with a wild rabbit whose abdominal muscles are strongly developed, or if the belly wall of the tame rabbit be supported by a bandage, the animal does not die.

This experiment illustrates an important point in the study of the pressure of the blood in the venous system, the enormous, almost determining factor, played by the muscles in the support of the vein walls. We must indeed look upon the body muscles functionally as a very important element of the walls of the veins themselves. It is this factor which must be considered surgically in the case of patients whose muscular system is relaxed from a long illness in bed. If they rise too quickly to a sitting position they may faint. A patient who has fainted is not to be placed in a sitting position but laid flat so that the hydrostatic pressure does not cause the blood to collect in the veins whose muscular walls, in this sense, are relaxed. A distended urinary bladder, a large cyst of the ovary, must not be emptied too rapidly or else an essential vacuum will be created into which the blood will run simply because of hydrostatic pressure.

The role played by hydrostatic pressure in the condition of shock is not clear, but it is a factor which cannot be ignored. It may indeed be that the blood collects in the veins of the splanchnic area simply because of hydrostatics; these veins are certainly the ones which have the least external support from the surrounding structures.

The hydraulic pressure of the blood is the result of a primary force produced by the contraction of the heart, acting against a resistance which is the result of the friction of a viscid fluid, chiefly in the small vessels of the periphery. What we commonly call blood-pressure is therefore the tension of the vessel wall produced by the systole of the ventricle and transmitted by an incompressible fluid. This tension of the vessel wall will depend upon the elasticity of the vessel wall and the force which stretches it. The elasticity depends upon: (1) The inherent elasticity, due to the presence of elastic membranes and fibers. Therefore the high pressure of the hardened arteries of advancing years is due to the fact that the force of the heart beat is carried straight to the periphery, not gradually taken up and absorbed by the expansion of an elastic tube. (2) The "tone" of the involuntary muscle cells, which cells persist in the smaller arteries and the arterioles, after the elastica has disappeared, and which form the most important structural element in the vessel wall of these smaller vessels. "Tone" is a term applied to that condition of the muscle cells which results in their being always stretched. If you cut any muscle the ends draw apart. This is a simple explanation of what the physiologists term "myotatic irritability," or the responsivity to the mechanical stimulus of stretching. (3) This "tone" depends upon nerve impulses and upon the presence in the circulating blood of the secretions of certain internal glands. The force acting to stretch the vessel wall will depend upon (4) The amount of blood in the vessel, which is in turn dependent upon the relation of the inflow to the outflow. The inflow will depend upon (5) the volume of blood forced out of the heart at each systole and (6) the rate of the heart beat. The outflow will depend upon the resistance, especially (7) the resistance in the arterioles and (8) the consistency of the blood. Under abnormal conditions we must also, as was just pointed out, consider the influence of (9) the hydrostatic pressure. In the background of it all there looms the omnipotent activity of (10) the vasomotor centers.

We might then define blood-pressure as a constant resulting from the summation of these ten variables, a concept which would naturally result in anything but a constant. I have mentioned these factors of blood-pressure not to impress you with the extent of my erudition, but to offer you perhaps the best explanation of why there are so many theories regarding shock. Since we do not know the cause we cannot determine upon which factor the causative agent works, and so, as in all fields of medicine where knowledge is lacking, a man will incline to the theory which fits best with his own mental process, or with the particular line of work in which he may be interested.

Thus we have Henderson, a physiologist whose chief interest is the study of the gas exchange of the body, including, of course,

the blood gases and the final interchange of gases between the tissue and blood. The importance of the exciting effect of carbon dioxide upon the vasomotor center stands out to Henderson as the one important factor, and shock is therefore a result of what he has termed acapnia, which, being interpreted, is the condition of there being not enough carbon dioxide in the blood to properly stimulate the vasomotor centers. Therefore the pressure falls. Since the carbon dioxide is a determining factor in the total acidity of the blood we next come into close personal contact with hydrogen ion concentration, and so on into the realms beyond the grasp of the simple surgical mind. The facts of carbon dioxide stimulation of the center of the vasomotor system are easily demonstrable. The opposite of this fact, a condition in which there is not enough carbon dioxide, I have never seen in my experiments, nor do I attach much weight to this theory of shock. Perhaps because I was born and raised a Presbyterian I have an abiding faith in the idea that things are arranged to meet certain ends. The breath of life is so fundamentally essential that I feel that when it fails we die, and die quickly, not by the long-drawn-out process characteristic of shock. I realize that this line of reasoning would not long stand the penetrating searchlight of serious questioning, and I trust you will take my theology simply for what it may be worth.

Now, Meltzer is a physiologist of long years' experience. He has always been deeply impressed with the forces which regulate and control activity. With every impulse to do there comes another impulse not to do; with stimulation comes inhibition. This is perhaps best seen in the phenomena of alcoholic saturation of the body. Men do things under this pleasing stimulus not so much because of the stimulation as because of the failure of normal inhibition. There is a certain type of acute failure of the circulation doubtless referable to inhibition, seen after a blow on the chin or the larynx or the solar plexus. That normal balance between stimulation and inhibition which results in the normal heart beat is lost because of a disturbance of the inhibiting mechanism—the heart fails. This theory has this much to commend it—it certainly accounts for certain conditions which are characterized by low blood-pressure, but it as certainly does not account for all the conditions commonly called shock.

The laboratory side is not alone in inclining to an explanation of shock according to the varying ideas and ideals of the individual. The clinician has, to my mind, introduced a great element of confusion into the whole subject, not by advancing too numerous ideas as to the theory of the thing but by his tendency to herd all fatal cases in surgery into the group of shock deaths. There is perhaps a psychological reason for this. It is doubtless a greater comfort to the relatives of the deceased to feel that their beloved was taken by some mysterious act of Providence, even perhaps a

certain pride that a case of such unknown nature should have occurred in their family, than it would be to feel that the patient was called to his reward as the result of the slipping of a catgut ligature, or the slipping of the surgeon's foot just as he was pulling the kidney out of the lumbar incision.

Now, if you will recall that I mentioned ten factors which entered into blood-pressure, a disturbance of any one of which might conceivably result in death with low blood-pressure, you will understand why I feel that it would add to our understanding of the problem, especially as regards practice, if we would separate the clinical conditions, which may be followed by low blood-pressure and consequent death into four groups:

1. I would define as syncope—from *συγκοπή*, a cutting short—the condition in which the blood-pressure falls because the great automatic centers are cut off short. A blow on the head may result in immediate syncope (cutting short) if the force be sufficient to cause that condition of the cerebral centers best spoken of as *commotio cerebri*, or else a cerebral edema or a hemorrhage follows and the intracranial pressure rises until it cuts short the function of the centers. The bounding pulse characteristic of the early stages of this condition is sufficient proof that the vasomotor mechanism is performing its function. It is obvious from the practical side that in such a condition the head should not be lowered or the pressure in the cranium would be merely increased by adding the factor of gravity in the venous system to an already dangerous pressure; nor would bandaging of the limbs, nor stimulation of the vasomotors, nor infusion of salt solution be indicated. The only direct indication is to relieve this pressure on the centers.

2. I would define as collapse—*collabere*, to fall together—the condition in which by the phenomenon called cardiac inhibition the machinery of the circulation fails—the heart falls to pieces, as it were. This is the condition explained by inhibition. Here again, vasomotor stimulation is not indicated; saline infusion, bandaging of the extremities, perfusion of blood—all this is contra-indicated; the engine is stalled, and putting on more load will not start it. In fact it is not unlikely that a venesection would be more of help in this condition than any effort which would increase the burden of the heart; the poor thing, remember, is having troubles of its own.

In the third place I would put hemorrhage. Without denying that loss of blood may be a factor in the production of the condition which appeals to my mind as true surgical shock I still object to grouping deaths due to hemorrhage under the caption of deaths due to shock. Death occurs after hemorrhage because the patient bleeds to death, and I would suggest that we forget that shock has anything to do with it.

Now, having ruled out head death, heart death, hemorrhage

death, what is left to constitute the group which is true surgical shock? Obviously the problem has lost in importance. True surgical shock is to my mind the condition marked by a gradual, persistent, progressive fall of blood-pressure such as characterizes certain cases after extensive crush injury with practically no loss of blood, cases of extensive burn, and many intra-abdominal conditions, particularly high intestinal obstruction, or ileus, and acute hemorrhagic pancreatitis. These are in my opinion instances of primary failure of the peripheral vasomotor mechanism, and I further believe that they are associated in some manner with a disturbance of adrenal function. Remember that the point where the vasomotor system accomplishes its work, transforms the energy of the centers into work, is not in the venous system, nor in the capillaries, but in the arterioles, and the mechanism which transforms energy into work is the musculature of the arterioles. We know that when the adrenals have been largely destroyed by disease we have the picture of Addison's disease, a picture characterized by the asthenia of the skeletal muscles and also by the asthenia of the musculature of the arterioles, hence the consequent low blood-pressure. We know that this true form of surgical shock is especially apt to follow a manifest toxemia, as after severe burns or in hemorrhagic pancreatitis. We know that the adrenals are almost specifically affected by some toxins, as in diphtheria, and we know that the prolonged administration of chloroform or ether certainly injures the adrenals. Further, the only way in which I have succeeded in producing experimentally the condition which to me compares with surgical shock is by the complete removal of both adrenals. From the practical side we know that adrenalin, since Crile's introduction of the drug in practice, has proved valuable in the treatment of this condition.

Now, it is my belief that adrenalin produces a good effect not only because it raises the blood-pressure, for which purpose alone it was introduced, but because it supplies a something which is certainly essential to life, and in these cases is apparently lacking. The treatment of surgical shock must therefore consist in the continued administration of adrenalin plus efforts to remove the causative factor. In cases due to a manifest toxemia it is certainly only symptomatic treatment to endeavor to sustain blood-pressure and not make an effort to remove the primary toxin. This is illustrated by Hartwell and Hoguet's experiments with dogs which otherwise would have died from high intestinal obstruction in three days, but which were kept alive for ten days or longer by the use of large amounts of saline solution, probably because the toxin responsible for the death of the animal is thereby more readily eliminated. I suspect that the problem of which vasomotor stimulant to choose, whether caffein or strychnin, etc., is probably a simple one—they are all aimed at the wrong end of the vasomotor system. Not

the vasomotor centers, but the mechanism at the periphery which transforms the energy of the vasomotor centers into work, needs stimulation; hence the good results of bandaging the extremities and using the pneumatic suit, which are mechanical supporters of the periphery, and hence the good of adrenalin, the chemical supporter of the periphery. This problem of surgical shock is primarily a clinical problem, and ought to be approached by the practical man who has not forgotten his theory.

You may have begun to wonder why I have ventured an attempt at clarifying a problem by the apparent method of making it more complex. I have done it from the stand-point of practice, for it is very clear to me that not all conditions of low pressure or shock should be treated by the same method. A patient coming with a head injury, or with an inhibited heart, or with internal hemorrhage, or with high obstruction, should not, I feel, be classed together from the stand-point of treatment. The head injury needs relief from the intracranial pressure; the heart case needs a heart stimulant and perhaps a venesection rather than transfusion; the hemorrhage case needs fluid in the vascular system, but not necessarily vasomotor stimulation; the high obstruction needs, first, removal of the toxin which is killing him, therefore washing out of the stomach and the duodenum if that is possible; washing out of the vascular system by saline solution, for the poison is in the blood; stimulation of the peripheral vasomotor apparatus, because it, too, is poisoned.

I have not as yet mentioned the doctrine of anoci-association. This is a remarkable teaching because it finds no basis in the known facts of physiology, yet it has accomplished far-reaching results in practice. The word is made up from alpha-privitive, the root of the word noxious or harmful, and association, and means the removal of all harmful impulses. The physiologist teaches that there is a constant stream of impulses from the periphery to the centers. Crile teaches that these impulses can in time wear out or fatigue the vasomotor centers and then we have shock. These external harmful impulses are especially numerous in a modern hospital. Crile holds that anoci-association begins with the doorman, and anyone who has seen the superb insolence of the average doorman will understand this point. This is undoubtedly the good of this doctrine, to treat the patient like a human being, but after the patient is under ether, those who are willing to follow Crile thus far fail to agree with him. In the first place, physiologists have been unable to produce a fatigue of the vasomotor centers after hours of peripheral sensory stimulation under ether, and secondly, it has been recently demonstrated by the use of the string galvanometer that afferent impulses do pass up the cord on sensory stimulation, but that they are abolished by ether anesthesia.[2]

[2] Forbes and Miller: Am. Jour. Physiol., 1916, xl.

I would define shock as a condition marked by a gradual progressive fall of blood-pressure with no obvious cause, such as hemorrhage, intracranial pressure or heart failure. I believe that it is due to a paresis or paralysis of the musculature of the arterioles. I am aware of the fact that many think otherwise. A recent writer says: "When the development of shock is carefully investigated it is apparent that the fall of arterial pressure is caused by diminution in the output of the heart. The fall is not due to the abolition of the peripheral resistance in the arterial system. Henderson and others have pointed out that no inhibition or fatigue of any sort occurs in the vasomotor system. On the contrary, this organism is intensely active in the effort to compensate the blood stream, nor is the heart itself weakened. When the pressure in the venous system is observed it becomes evident that the apparent cardiac failure is the result of diminution of the pressure and volume of the venous stream to the right heart. The etiological sequence in certain forms of shock at least appears to be venous stasis, cardiac failure and fall of arterial pressure."

I am ready to agree that the central vasomotor nervous system shows no evidence of failure and that the heart shows no weakness, but I still believe in a primary failure of the musculature of the arterioles for several reasons:

1. They are the only parts of the vascular apparatus capable, so far as we know, of being paralyzed. The idea that the veins are dilated other than passively, implies a mechanism which has never been demonstrated.

2. A dilatation of the arterioles would necessarily be expressed in the veins because the pressure of the heart would, by this dilatation, be allowed to pass directly into the veins. There would be no congestion or stagnation in the arterioles because there must always, as long as there is any circulation at all, be a greater pressure in the arterial side than in the venous side. In this connection the fact of anatomy might be recalled, that the arterial system is empty in the cadaver.

3. The fact that physiologists find the vasomotor centers intact proves only that the centers are intact. I think they are looking at the wrong end of the vasomotor system. Why do I not go to work and prove it? Because thus far I have seen no way of demonstrating my contention. We must at any rate remember that the point where the controlling force of the vasomotor center, the energy-producing mechanism, accomplishes work, is in the arteriole. The vasomotor center is the dynamo. The nerves form the transmission system. The arteriole is the motor which transforms the energy produced by the dynamo into work.

4. What I consider shock is a manifestly toxic condition. High obstruction, acute pancreatitis, severe burns, severe infections, —crush injuries—all of these are conditions marked by the poison-

ing of the body with the toxic products of protein break-down. I suspect that these toxins injure the adrenals and the adrenals I believe are concerned in the preservation of the tone of the muscle cells of the arterioles.

5. The only way in which I have been able to experimentally produce anything which looks like shock to me is by the removal of the adrenals. After the removal of the adrenals the content of the intestinal tract contains a poison identical with, or at least similar to, the poison found in high obstruction. This fact has appeared in the work of Dr. Hendrix and myself this winter, and suggests a possible relation between high obstruction and the adrenals.

6. The relation between psychic shock and traumatic shock is compatible with my ideas. The relation between fear and anger and the adrenals is capable of experimental proof. The relation between psychic shock and that profound disturbance of metabolism known as thyrotoxicosis is universally admitted.

And, finally, my ideas of shock are entirely compatible with the best and latest in treatment. Porter,[3] as a result of his studies of shock at the front, advises:

1. A special position of the wounded so that the abdominal vessels shall be higher than the heart and brain (in other words, counteract the effect of hydrostatic pressure).

2. Heat. (The use of heat in shock is not clear to me. It seems like the empirical combating of a symptom, but it is universally used in practice.)

3. Intravenous injections of saline solution.

4. Intravenous injections of epinephrin. (Both of these procedures support the peripheral mechanism. Adrenalin is certainly purely a chemical supporter of the peripheral mechanism.)

5. The transfusion of blood in certain cases.

6. The observation of the diastolic pressure every half-hour, as an index of the condition of the patient. (In other words, we are dealing with a disturbance of the blood-pressure. Therefore, keep track of the blood-pressure by the only possible means, and if it be found to be failing, apply the principles of preventive medicine.)

What is the relative value of saline infusion and transfusion of blood? When should the one or the other be used? An answer to these questions must be based on personal opinion rather than on experimental or clinical fact, I think, because the men who favor any given method seem to become soon obsessed with an enthusiasm which tends to cloud the accuracy of their observations. The impartial, accurate observer is a rare bird.

The operation of transfusion of blood has a very interesting history. There are records which seem to show that the operation was practised in very ancient times. A review of an ancient Jewish

[3] Boston Med. and Surg. Jour., 1916, clxxv, 854.

writing which was shown to La Martinière by Ben-Israel Manasse, a rabbi of the Jews of Amsterdam, contains the following words: Naam, prince of the army of Ben-Adad, king of Syria, being attacked with leprosy, resorted to physicians who, in order to cure him, withdrew blood from his veins and replaced it with other blood. Perhaps this was not a transfusion, but early serum therapy. At a much later day, Libavius, in his treatise of the sacrifices of the Emperor Julian, speaks of transfusion as having been an eye witness of an operation of this sort.

About the middle of the seventeenth century, following upon the discovery of the circulation of the blood by Harvey in the early part of this century, together with the then prevailing philosophical conjectures concerning the real function of the blood, the question of the transfusion of blood became of unusual interest. Serious discussions were held on points such as if the blood of a sheep were transfused into a man, would he grow wool and horns, and the treatment of incompatibility of temperament (or temper) of husband and wife by mutual transfusion was seriously proposed. In the year 1667 Denis, professor of philosophy and mathematics, at Paris, performed the first transfusion operation upon a human being, that is, the first operation the account of which we find preserved in an original record. In the fall of the same year Lower and King operated in London.

The German physiologist Landois, in 1875, collected 374 cases of transfusion of human blood, of which in 150 cases the result was favorable, in 180 unfavorable, doubtful in 12, while in 3 no result was to be expected, and 2 died during the course of the operation. He also collected 129 cases of transfusion of animal blood into the human body, of which 42 resulted in a cure or continued improvement, 25 in transitory improvement or doubtful success, and 62 were followed by no improvement and death. These figures are of little value, all dating from the preaseptic days, but I give them to you to show the extent of the practice of transfusion, especially remarkable in those days in which there was relatively little surgery practised. Further, these figures show that the operation has always had a strong hold on the imagination both of the public and the surgeon, and there are more recent indications that transfusion has more often appealed to the poetic sense than to the common sense.

Landois was the first apparently to study this problem, and he arrived at two important and fundamental conclusions: (1) He observed that the mixture of the blood of two different species results in the destruction of one or both bloods—in hemolysis—and it was this work which laid the foundation for all the subsequent work on hemolysis and bacteriolysis, with the discovery of all the methods of serum diagnosis now of such invaluable aid in clinical work. Landois further demonstrated that an animal dies of

hemorrhage at a time when there are still plenty of red cells left in the body to carry on all the functions of the red cells, but when the fluid column of the blood has fallen so low that the heart cannot get a grip on this fluid column; in other words, death from hemorrhage in the normal animal results from the mechanical disturbance of the heart action rather than from the loss of a chemically vital fluid. Landois found that death after hemorrhage could be prevented if this fluid column were restored by the addition of fluid, and he introduced the method of saline infusion for the treatment of hemorrhage and shock. So saline infusion completely displaced

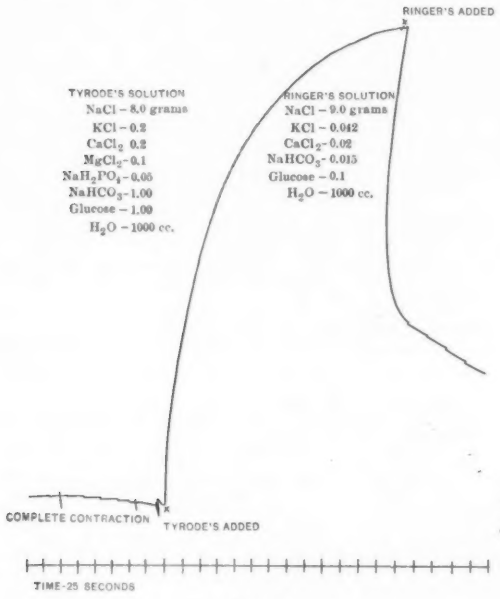

FIG. 1

blood transfusion for many years until transfusion was revived, and thus the pendulum swings backward and forward until after many swings through an arc, which gradually grows shorter and shorter, the pendulum stops at the exact center of the arc which represents the truth.

The demand for fluid by the body after hemorrhage is so insistent that fluid is taken up rapidly from the tissues, from the great serous cavities, from the stomach, intestines, the large intestine; the kidneys stop excreting. Therefore we make use of these facts in surgery. We give patients freely to drink; we inject saline into the tissues subcutaneously; we fill the large bowel with saline and

finally we inject saline directly into the veins. These methods are all of value and they differ only in the speed of attainment of the end-result.

When shall saline be used and when transfusion of blood? Now, salt solution has the great advantage of being always on hand in sterile form; a hollow needle, not too small, a rubber tube and a funnel, introducing the needle into a vein, directly through the skin—making an incision to expose the vein indicates a lack of refined technic—and the life-saving process is started. I personally firmly believe in the teaching of Landois. I feel that salt

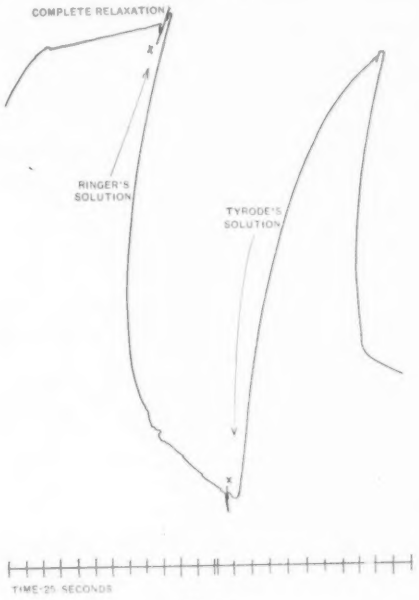

FIG. 2

solution does all that transfusion can do in the acute cases, perhaps not in the late anemias, and only two things stand out to the disadvantage of the salt solution. You may remember that I defined blood-pressure as the result of the friction of a viscid fluid in the small arteries of the periphery. Salt solution does not possess the normal blood viscosity, and it may be for this reason that it does not work sometimes. And, again, rarely, salt solution seems to leak through the lungs so rapidly as to cause acute edema. Some day I believe someone will find some colloidal addition to give saline a viscosity comparable to that of the blood, and this objection will then be done away with.

There is another point concerning salt solution which I believe worth mention. If we have learned anything from the recent work with the Dakin solution in the treatment of infected wounds, it is to my mind the fact of the importance of a surgeon's either knowing chemistry, or, since that seems to be such a disheartening task, having associated with him a real physiological chemist. Let me emphasize again the facts that I have endeavored to point out, that blood-pressure is the result of the factors found in the vessel wall, chiefly the smooth musculature, acting upon the factors found in the fluid within the vessel. A very interesting point in this relation is found in a study of the technic of using smooth muscle preparations for the testing of certain substances such as adrenalin. For this test a strip of smooth muscle is suspended in warm oxygenated Ringer's solution, and if the Ringer's solution be not exactly right all sorts of results may be expected. I have here, for example, the actual tracing made by a strip of longitudinal muscle from the small intestine of a dog which gave either complete relaxation or complete contraction, depending only on which two of Ringer's solutions was added. Therefore I venture to raise the question whether some of the untoward results obtained after saline infusion are due to the fault of the theory, or simply to the fact that the saline solution was made up by a combination of a trained nurse and a tablespoon instead of by a chemist who realized the sensitiveness of living tissue to slight changes of concentration.

Do I not then believe in transfusion of blood? I fear I am not what you would call an extreme enthusiast. Let us think for a moment of what the blood is and does and let us begin by getting out of our heads the idea that the blood is that vital life-giving fluid which can be cleaned by a spring tonic or which can become diseased with any result, from pimples on the face to cancer of the uterus. The blood is just about as vital as a bucket of water and just as full of life. It contains and carries to the tissues just what and only what the tissues put into it. It is a purely passive, inert, lifeless stream, carrying canal boats loaded with goods, the red cells, themselves again passive. The red cells are alive, yes, but only mildly so, and no more so than certain chemical agents, sponge-platinum for example. The white cells are alive in a more real sense, but they are not in the blood stream because the blood stream wants them; they were merely playing on the bank and fell in.

Please do not think I am casting aspersions on the blood. I have the highest respect for it as a common carrier, no respect at all for it as an active agent, endowed with a free will; and because I feel as I do toward the blood, I fail to see that a transfusion can ever be much more than a symptomatic treatment. You put in some fresh blood and it may do good for a little time, but I do not see how you have transferred with it any incentive to a diseased bone marrow, for instance, to brace up and lead a decent life.

One hears many favorable reports of transfusion, too many, however, like a case I recently saw. An old man, nearly seventy, suffered from a severe chronic anemia. He had several transfusions and improved somewhat. He was suffering from an extensive pyorrhea and finally had his teeth removed. He improved rather remarkably. Transfusions still were continued. Those who will may say the transfusions did it; those who will may say that the removal of the focus of chronic infection did it. All I am sure of is that the transfusions did not kill him; but after one of these transfusions he suffered a chill, and that suggests another reason why I am no enthusiast. The blood, though passive, is an extremely complex solution and suspension, and I for one have a most profound respect for any combination of physiological chemicals which require only the very slightest change to transform them from normal compounds to virulent toxins. I am frank to say that on theoretical grounds I am afraid of transfusion, and therefore consider it only an operation of last resort.

I know that there be many who will land merrily with both pedal extremities upon my ideas concerning transfusion. No doubt I am in a very small minority, a small band of wilful men. I nevertheless do not hesitate, for I feel sure that there are many who might welcome the moral support of such a minority report. I have heard within the last few weeks of two fatal cases of transfusion in the hands of good men. I would encourage the reporting of these failures of surgery, for when surgeons stop reporting successes and report only their failures, we will note an important advance. The art of surgery demands results, but the science of surgery demands the truth!

MELANOSARCOMA OF THE RECTUM, WITH THE REPORT OF A CASE.

By John W. Churchman, M.D.,
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The rarity of melanotic tumor of the rectum is sufficiently attested by the fact that many surgeons of wide experience have never seen a case. The rather striking fact that the condition is not unusual in horses has long been known; but Ashton[1] in a treatise on diseases of the rectum and anus published in 1857 did not "know whether melanotic cancer of the rectum had been observed in man, though I have seen in the autopsy room several cases of melanotic

[1] On the Diseases, Injuries and Malformations of the Rectum and Anus, etc. London, 1857, 2d ed.

deposits in the ischiorectal fossa." The disease had, however, been recognized fairly early in man; by Virchow,[2] who in his Lectures on Tumors had mentioned but not accurately described a "melanotic sarcoma carcinomatodes;" by Maier,[3] who had described a melanotic "fasersarcom" of the anal orifice with metastases in all the organs; and by Eiselt,[4] who had described 2 cases. Even in 1904 Sandner[5] in an Erlangen thesis was able to collect only 15 cases.

The subject was, however, exhaustively studied by Chalier and Bonnet,[6] who publishing in 1912 and 1913 were able to assemble 64 cases; to these my own review of the literature has added 2 cases, which with my own case herewith published makes the total of reported cases to date 67.

It is certain that the anorectal region is one of the rarer sites for primary melanotic growths. Eiselt in 1860 found only 2 rectal melanoses out of 104 melanotic sarcomata and about the same figure was obtained by Dieterich in 1887. It is thus evident that the rectal melanotic sarcoma is much rarer than the ocular or cutaneous.

The history of my case is as follows: The patient was a man, aged fifty-four years. He had suffered from rectal pain for about seven months, which was not severe, however, until about three weeks before admission to the hospital. With the onset of the pain there was an increase in constipation, and physic had been required every other day for a few weeks before admission to the hospital. The appearance of some growth near the sphincter had led to a diagnosis of hemorrhoids, for which the patient had been operated in another hospital. The rectal pain, increase in constipation, and some pain along the costal margin had been the only clinical features of the disease. On examination, a flattened cauliflower-like growth could be readily felt in the lower rectum and spreading out toward the skin of the perineum. The growth was flattened out and had no definite pedicle. The finger could easily be passed above it and examination showed no mechanical reason for obstruction. In the right groin there was a large hard gland about the size of a pigeon's egg which was free from tenderness and had been present a month. No mass could be felt in the abdomen. There was no evidence on rectal examination of any involvement of the prostate or bladder in the growth. At operation the gland in the groin was first removed, and on section its gross appearance suggested a melanotic sarcoma. The abdomen was opened by an incision recently described by me. No mass was found in the descending colon or rectum, though both of these were somewhat hypertrophied. The hand was swept up

[2] Vorlesungen u. Geschwülste, Bd. ii.

[3] Berichte ü. die Verhandlungen der Gesellschaft zur Beförderung der Naturwissenschaften in Freiburg i B, 1858.

[4] Prager Vierteljahres Scrift f. Prakt. Heilk., 1861, Bd. lxx.

[5] Ein Fall von primaren Melanosarkom d. Rectums, Ansbach, 1904.

[6] Les tumeurs melaniques primitives du rectum, Revue de Chirurgie, 1912, xlvi, 914; 1913, xlvii, 64, 235, 372, 563.

over the liver which was not much enlarged but studded with nodules the size of a small marble. No other metastases could be found in the abdomen. The microscopic examination of the gland (Fig. 1), as well as of a small piece of tumor removed from the rectum (Fig. 2), showed it to be a melanotic sarcoma.

It seems fairly certain that these interesting tumors originate rather in the anorectal region than in the rectum itself, and are skin tumors primarily and mucosal secondarily. This point is pretty generally agreed upon as regards the site and origination of the new growth. As regards their histological classification there is some dispute. As Virchow's name for them ("melanotic sarcoma carcino-

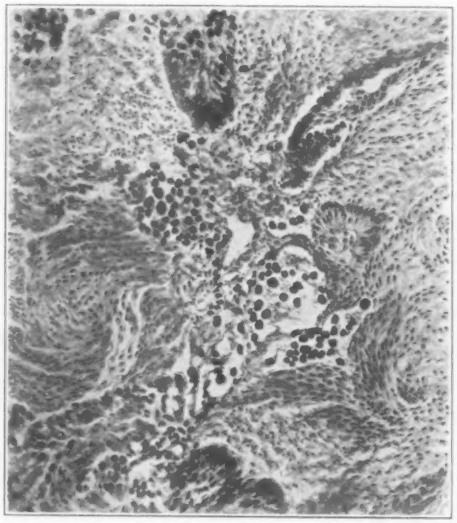

FIG. 1.—Section from inguinal gland.

matodes") indicates, this dispute has concerned itself with the question as to whether these tumors should be regarded as sarcomatous or carcinomatous. It was Strohmeyer, in 1844, who first called them melanotic sarcomata, Laennec's notion having been that all melanotic tumors were carcinomatous. To the former school Tuffier[7] among modern writers inclines. But Chalier and Bonnet, who have studied the subject exhaustively, are quite positive in their contention that melanotic tumors of the rectum are in reality anorectal epitheliomata of the Malpighian type, that they are ectodermal, having their point of origin in the anal region at the

[7] Arch. gén. de méd., 1888, xxx, 29.

expense of the Malpighian epithelium, that they are essentially cutaneous epitheliomata.

Many of the clinical features of these tumors are quite characteristic. They are usually situated low in the rectum, are often pedunculated, and may be either single or multiple. *The caliber of the rectum is usually little affected.* The mucosa is as a rule moveable and uninvaded, the perirectal tissue invaded. The sacrococcygeal glands are often, and the inguinal glands usually, involved: this inguinal adenopathy is often unilateral, and is the rule in melanotic, though the exception in non-melanotic, sarcomata of the rectum. In contrast with carcinoma this tumor does not tend to invade or

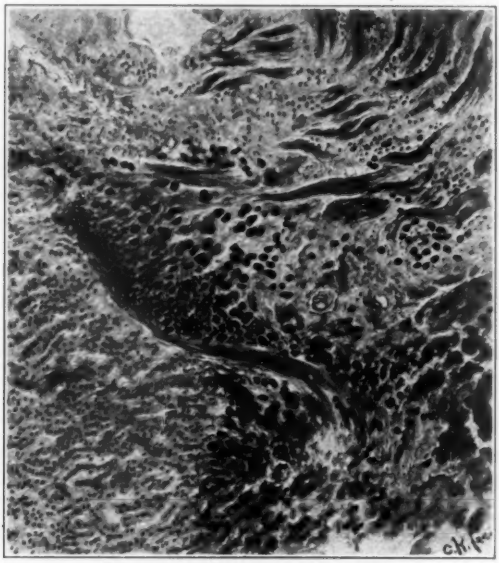

FIG. 2.—Section from rectal growth.

become adherent to neighboring organs. For example, the sacrum is never involved (save in cases of general metastasis) nor is the bladder or vagina. The tumor tends, however, to rapid multiple generalization. The peritoneum is usually involved, the liver in about 87 per cent. of the cases, the lungs and pleuræ in 50 per cent.; the heart, the kidneys, the skin, the retrorectal, mesenteric, retroperitoneal and other glands and, in rare instances, the intestines.

Melanotic tumors of the rectum seem to offer some exception to the rule that pigmented tumors are highly malignant. Malignant they certainly are and their malignancy is of the worst type, for it manifests itself in rapid multiple metastasis, often at great distance

from the primary growth. There are, however, cases on record in which the patient has lived and remained in good health long after the growth was discovered and operated upon. Francois-Dainville,[8] for instance, showed before the Anatomical Society of Paris, a patient in perfect health who had been operated on four and one-half years previously for melanotic sarcoma of the rectum. *Metastasis at a distance should be emphasized as an important feature of this disease; inguinal adenopathy associated with rectal tumors—particularly if the adenopathy is unilateral—should make one suspect a melanotic sarcoma; and in exploring from above the hand should always be first swept over the liver, to see if metastases are present. Metastases will be found in 80 per cent. of the cases, and this large group of patients will be spared an unnecessary intestinal resection.*

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THE PROGNOSIS OF GALL-BLADDER INFECTIONS.

By John H. Gibbon, M.D.,
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It is well in discussing any phase of surgery of the bile passages to have in mind that practically all lesions for which surgical interference is required have their origin in infections of the mucous membrane by microörganisms. The one condition for which we most frequently operate is gall-stones, and as Sir Berkeley Moynihan so tersely expresses it, "Every gall-stone is a monument erected to the evil memory of the germ which lies buried within it." Even malignant disease of the gall-bladder, if primary, in nearly all instances has its determining cause in irritation and ulceration caused by gall-stones which themselves are the result of infection. There can therefore be no question that a microbic infection is the starting-point of nearly all the diseases of the gall-bladder for which we operate, but the type of organism, except in the acute infections or the acute stage of the infections, plays little part in the prognosis.

The colon bacillus is by far the most frequent cause of the infec-

tion, and then the typhoid bacillus, the staphylococcus, and the streptococcus in the order named.

Acute cholecystitis, especially that due to the typhoid bacillus and occurring during or shortly after typhoid, is liable under proper treatment, to subside without operation, and only requires operation when there is not in a day or two a prompt subsidence of all the symptoms. The acute cholecystitis which is preceded by a history of gall-bladder symptoms extending over a considerable period of time will certainly require operation during or after the attack, and in these cases the prognosis is grave if the operation is delayed in the presence of marked and continuing symptoms of sepsis, especially if jaundice is present. The gall-bladder, when acutely infected or in an acute exacerbation of a chronic infection behaves very much as does the appendix, and the prognosis is about the same in each, excepting, of course, a perforative peritonitis is not so likely in the gall-bladder cases; but gangrene, perforation by stones of the gall-bladder and intestinal walls, acute infection of the bile ducts and the pancreas and occasionally a general peritonitis may result. I am convinced that in the majority of instances the primary infection of the gall-bladder does not give rise to the symptoms of acute cholecystitis, but that the infection occurs insidiously and the supposedly acute infection is often as a matter of fact an acute exacerbation of an old infection, due to interference with the emptying of the gall-bladder by a stone. The cases of acute cholecystitis which are not apt to subside, and which rapidly pass on to gangrene and peritonitis, are those due to the staphylococcus and the streptococcus or to complete occlusion of the cystic duct by a stone. Some of the worst cases of acute cholecystitis I have operated upon have been those in which no stone was present, but an acute infection by one of these organisms. The symptoms of severe septic infection are very marked in these cases, and if drainage of the gall-bladder is not done promptly, before the infection extends to the ducts and the liver, the prognosis is very grave. If jaundice is present it indicates a blocking of the hepatic or common duct by edema, and should add greatly to the gravity of the prognosis. If drainage is established early the prognosis is remarkably good, and if it is done late, even after gangrene has occurred, but before a general cholangitis has developed, it is not bad. It is astounding how patients recover after operations which reveal an extensive gangrenous condition of the gall-bladder and how grave the condition becomes when there is an obstruction to the flow of bile through the liver and ducts, as indicated by jaundice. I am now speaking of the acute infections without stones. When the obstruction to the flow of bile is due to the lodgment of a stone or stones which can be removed through an incision in the common duct and free drainage established the outlook is quite favorable, even in very sick patients.

As a basis for this paper I have studied my last 200 operations on the gall-bladder and ducts and have divided them into two series of 100 each. At first I thought 100 cases would be enough from which to draw conclusions, but later determined to go back over another 100 for verification and comparison of my conclusions. No case has been omitted because the lesion was not in the gall-bladder or ducts, and therefore in the list are a number of cases of cancer of the head of the pancreas and two of cancer of the stomach complicated by gall-stones. The inclusion of these cases greatly increased the operative mortality. We have also included in the mortality list a number of cases in which death did not occur for three or four months, and was due only indirectly to the operation.

So far as the cases of acute cholecystitis, in which operation was done during the height of the attack, are concerned there is no difference in the two series. In the 200 cases there were 8 cases without stone and 2 deaths, each due to septicemia, and 35 cases with stone and 10 deaths. The causes of death in these varied greatly: One was from acute hemorrhagic pancreatitis, present at the time of operation; 1 from hemorrhage from the gall-bladder and ducts two weeks after operation; 1 from suppurating pancreatitis four months after operation; 1 from pulmonary embolism three months after operation and following a thrombophlebitis of the saphenous vein; 1 from abscess of the liver and of the spleen present at the time of operation; 2 from septicemia; 1 from cirrhosis of the liver; 1 from cholangitis; 1 from acute endocarditis. These deaths comprise nearly one-half of the total number in both series of cases, and in most instances might have been prognosticated at the conclusion of the operation.

It must be apparent that an acute cholecystitis which does not promptly subside under treatment or which is characterized by severe symptoms of general infection and especially by jaundice is a very serious condition and demands prompt operation, which should comprise free drainage of the biliary tract. The cases of common duct infection, especially those in which we find the duct filled with a muddy sand which must be scooped out with a spoon, I think are the most serious cases we see excepting those complicated by an acute hemorrhagic pancreatitis. In looking over these fatal cases I have been impressed with the fact that the majority of them have been private cases and not ward cases, and that in nearly all of them there was ample warrant for operation long before the acute exacerbation of the infection occurred.

In the 200 cases cancer of the gall-bladder was found in 8 cases, and it was apparently primary in 7 of these. In but 1 case could a radical operation be done, and in this case a section of the liver was removed with the gall-bladder. The patient is alive and well today, more than four years after operation. In one of the fatal cases I was uncertain whether an obstruction of the duodenum was due to cancer or syphilis. Cancer of the pancreas was found

in 4 cases; cancer of the ampulla in 1 case and cancer of the stomach (with gall-stones) in 2 cases. In these 14 malignant cases there were 11 deaths. It is apparent then that cancer of the gall-bladder or of the pancreas carries with it a high operative mortality. Another observation of practical value is that gall-stones were responsible for nearly all the cases of primary cancer of the gall-bladder. Having accounted for 23 deaths, 12 in the acute septic cases (most of them having a cholangitis), and 11 in cases complicated by malignancy, I find 5 deaths unassigned; 1 was due to pulmonary embolism in a case of cholecystectomy; 1 to subdiaphragmatic abscess following choledochostomy; 2 to pneumonia, and 1 to complete suppression of urine.

One naturally asks whether the type of operation influences the prognosis, and I can say definitely that simple drainage of the gall-bladder in the hands of most operators is somewhat safer than cholecystectomy or the operations involving the opening of the common duct or the duodenum; but when these operations are plainly indicated simple drainage of the gall-bladder will not in most instances save the patient or relieve him of his symptoms. In my last 100 cases I have removed the gall-bladder fifty-three times and in the previous 100 cases it was removed but eleven times. In reviewing the two series I cannot discover any difference in the mortality. In the 200 cases the common duct was opened and stones removed nineteen times and the duodenum opened twice to facilitate the removal of a stone from the ampulla. In nearly all the malignant cases no operation on the gall-bladder or ducts was done.

The prognosis as to the recurrence of gall-stones is an interesting one, and my own experience leads me to believe that a true recurrence is very rare. I have operated a second time upon four of my patients for stone. In one I found a stone in the common duct which I believe was overlooked at the first operation two years previous when I had removed a great many stones from the gall-bladder and seven from the common duct. In another operated upon seven years after the first operation because of an intermittent biliary fistula I found one small stone; at the first operation the patient was very ill from a suppurating cholecystitis and cholangitis, and I had removed about 200 stones from the gall-bladder. I am rather inclined to think in this case a tiny stone was probably overlooked in the cystic duct. The third case was that of a physician who developed a recurrence of his symptoms about three years after his first operation, when I had removed 70 stones from the gall-bladder. I thought that in this case that again I might have overlooked a stone, but when I reopened the gall-bladder I found 25 soft mulberry stones, undoubtedly of recent formation. In the fourth case at the first operation I could feel no stones in the gall-bladder which appeared normal, and I did not open it. I attributed the symptoms to a band of adhesion extending from the pylorus

to the abdominal wall. Three and a half years later at the second operation I found a single gall-stone. In this case it is quite possible that the stone may have been present at the first operation. In the last 3 cases the gall-bladder was removed at the second operation. All of these cases are not included in the list of 200 under consideration, but they comprise my entire personal experience with secondary operation for stone. In but 1 case, therefore, have I seen an undoubted redevelopment of gall-stones following a primary operation for stone. This experience, I think, answers very well a query which is constantly put by the patient.

A rather interesting fact which is shown by a study of these 200 cases is that the danger of hemorrhage during and after operation on patients deeply jaundiced is practically eliminated by the prophylactic injections of horse serum. Although scores of these patients had been deeply jaundiced for varying periods of time and the coagulation time greatly reduced, there was but one death from hemorrhage, a continuous oozing from the mucous membrane. Coagulation tests are very necessary in jaundiced patients in order properly to estimate the risk of operation.

The opening and drainage of the common duct when indicated by the presence of a stone not only does not add to the risk of the operation, but if carefully carried out reduces it. The passage of inflexible probes into the ducts to ascertain if the obstruction has been entirely removed is dangerous; flushing the ducts with sterile water is a much safer method. It is much safer to open the duct than to crush the stone or forcibly push it up into the cystic duct or gall-bladder. When a stone is wedged in the ampulla it is often better to remove it through an incision in the duodenum than through the duct.

In conclusion, I would say that the mortality in gall-bladder infections depends very largely upon whether or not a cholangitis is present and that a persistent jaundice accompanied by general symptoms of sepsis is of grave import and calls for prompt drainage through the gall-bladder or common duct, or both; that a patient having undoubted symptoms of gall-bladder infection should not be allowed to postpone operation until an acute exacerbation of the infection occurs; that even far-advanced and neglected cases of infection of the gall-bladder alone give good results following operation; that jaundice due to stone in the common duct in the absence of symptoms of sepsis is not necessarily a grave symptom if prompt operation is done; that the high mortality following operations occurs in the cases of long-standing gall-bladder symptoms with acute exacerbation of the infection and in cases of malignancy of the gall-bladder and pancreas; that the use of horse serum has practically eliminated the danger of hemorrhage due to long-standing jaundice; that the recurrence of gall-stones after thorough operation is extremely rare; and finally, that more is to be learned from the study of our failures than our successes.

THE NERVOUS MANIFESTATIONS OF SYPHILIS OF THE EYE.[1]

By Joseph Collins, M.D.,
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I interpret your invitation to discuss the subject of the nervous manifestations of syphilis of the ocular mechanism as a request for a statement of my experience: (1) As to their frequency in neurological practice; (2) their clinical display; (3) their amenability to treatment. I have taken from the first division of the Neurological Institute the statistics of the past seven years. During that period the diagnosis of syphilis of the nervous system has been made more frequently and satisfactorily than it was in former years before study of the cerebrospinal fluid was a routine method of investigation. In approximately 4000 cases of nervous, mental and metabolic disorder there were 790 cases of syphilitic disease of the nervous system.

The accompanying tables show in a general way how these cases were distributed clinically. It should be remarked in passing that it was by design that so many were put under the general caption of cerebrospinal syphilis. It is from this group of cases that we hope eventually to differentiate recognizable clinical entities dependent upon syphilis. Syphilis of the nervous system includes diseases that have their sole origin in syphilis, such as tabes and general paresis, also many diseases that may have their origin in other causes, such as myelitis, encephalitis and arteritis. It includes also indefinite symptoms or association of symptoms variously diagnosticated, usually of the chief complaint, such as headache, insomnia, neuralgia, rheumatism, arthritis and neurasthenia. The essential lesion of cerebrospinal syphilis is lymphocytic infiltration of the pia usually associated with a circumvascular round-celled infiltration of the parenchyma immediately beneath it. This may or may not be associated with changes in the bloodvessels, and it may be of any size and distribution. Varying with its size and distribution will be the clinical display within certain limits. In certain cases this process progresses to such extent as to give rise to symptoms that justify the diagnosis meningitis: basilar, cortical, spinal. It may, on the other hand, give rise to symptoms which justify only the diagnosis of neuralgia or rheumatism or neurasthenia or any other term, popular at the time, to express malaise. It is in such cases that the designation cerebrospinal syphilis is the one that facilitates a conception of the pathological process and its treatment. For instance, it is not so very long ago that it was

[1] Read at a combined meeting of the New England Ophthalmological Society and Boston Society of Psychiatry and Neurology.

generally contended that the ocular palsies of tabes were of nuclear origin, while those of cerebrospinal syphilis were of root origin, but with the disappearance of the conception of so-called parasyphilitic disease this attempt at differentiation has been abandoned.

Syphilis writes its signature upon the individual whose nervous system has been invaded by the Spirocheta pallida, by disordering the size, shape and contour of the pupils, and in many instances by destroying their responsiveness to light and shadow. One-half of all our cases of syphilis of the nervous system were cases of tabes and general paresis, and in 335 of these 395 cases the size, shape and circularity of the pupil were disordered. Disorder of the circularity of the pupil has come to have such significance to me that in the absence of obvious attributable cause, such as iritis, scleritis or similar inflammatory conditions, it is considered suggestive of syphilis and warrant for study of the cerebrospinal fluid. It is therefore important to know whether such alterations occur in healthy individuals. It must be admitted that they do. For instance, Uhthoff found such anomalies two hundred and fifty-six times in 14,392 cases, *i. e.*, nearly 2 per cent. Others who have investigated much fewer cases found a larger percentage. Ivanoff, 9 per cent.; Mantoux, 5 per cent.; Dufour, 4 per cent.

We do not know whether the individuals upon whom these statistics were based were in reality healthy. Many cases of syphilis of the nervous system are recognized today which ten years ago were not even suspected. They are diagnosticated because we have learned empirically to suspect them, because we have given to slight pupillary abnormalities greater significance, and because we have learned the value of information given by them. Such abnormalities need not mean the existence of syphilis. They may merely indicate that syphilis had existed and had been cured.

In 467 of 790 patients it was noted that the pupils displayed the Argyll-Robertson phenomenon. It is interesting to note that in proportion to the thoroughness of examination of patients who have syphilitic disease of the nervous system is the increased frequency with which the *A–R* phenomenon has been found. Indeed, it may be said that the only infallible sign of syphilis of the nervous system is the failure of the pupil which is not fixed mechanically to react to light. In twenty-five years' experience in hospital and private practice I have never encountered an example of *A–R* pupil in non-syphilitic individuals. It should be noted here, however, that isolated cases have been recorded by Mees, Margulies, Nonne and others, in which such phenomena occurred in chronic alcoholics and in which there was no history of syphilis, and no evidences of its existence were revealed by examination of the blood serum and cerebrospinal fluid. In one case (Nonne) the examination of the tissues after death did not

reveal lesions of syphilis. Other instances of loss of the pupillary light reflex have been recorded in syringomyelia by Dejerine and Miraillé and others, in disseminated sclerosis by Van Rad, in diabetes by Biermann, in head injury by Guillain, Franke and others, and in pineal gland tumor by Southard.

The statistics that have been often cited to support the statement that *A–R* pupils occur in non-syphilitics in which the blood serum and cerebrospinal fluid have not been examined are useless, and it only serves to obscure the issue to quote them. We now know that some cases formerly diagnosticated as syringomyelia, disseminated sclerosis and progressive muscular atrophy are sometimes founded in pathological process which has its origin in syphilis.

It may therefore be said that the *A–R* pupil bespeaks the existence of previous or existing syphilitic disease of the central nervous system. Like all rules this one may have exceptions.

What does the *A–R* pupil mean for the individual who has it? It is generally held that the prognostic significance is grave and that it heralds often a long time in advance the coming of tabes and general paresis, and other serious cerebrospinal manifestations of syphilis. In a general way this is undoubtedly true, but I have among my histories not included in these statistics no less than 22 individuals who have had *A–R* pupils for upward of five years, some as long as twenty years. In none of them has there been any indication of active syhilitic disease of the central nervous system. They are to be interpreted as indications of syphilis that has come to a stand-still spontaneously or as a result of treatment. I mention these cases particularly, as many years ago I was lessoned by one of them. A man, aged forty-five years, who had typical *A–R* pupils, and to whose family I communicated my fears of their serious significance, has remained at the head of a large organization which has required most exacting attention, and he has remained well until now, when he is beyond sixty years.

In every instance in which the *A–R* pupil is encountered accidentally, as for instance in routine ophthalmological examination, or elicited during the course of general examination, it is incumbent upon the physician to examine the blood serum and cerebrospinal fluid. In the event of their being found negative the physician is not justified in other conduct than that of watchful waiting. When evidence of syphilis is found in the blood and cerebrospinal fluid in an individual who has *A–R* pupils the condition must be looked upon as grave and calling for active and vigorous treatment, but it does not necessarily mean that the possessor of it is doomed, and it may indicate only the road he has travelled.

Dreyfus[2] says that isolated pupillary disturbances in syphilitics which he found in 35 to 40 per cent. of the cases should not be

[2] München. med. Wchnschr., 1912, No. 30.

considered of too grave pathological import. They may be merely indications of a former syphilitic infection or drenching of the nervous system which has gone on to recovery.

Assman[3] comes to the same conclusion that cases of isolated pupillary anomalies without alteration in the cerebrospinal fluid are not of grave significance and those with alterations in the cerebrospinal fluid are to be taken as indicative of oncoming tabes or general paresis.

It is my conviction that if 100 individuals, aged fifty years, who had syphilis during early manhood and consider themselves well, were examined that a very considerable percentage of them would be found to have pupillary anomalies which we consider to be syphilitic.

THE SYPHILITIC EYE-MUSCLE PALSIES. Next in importance to pupillary disturbances are the paralyses of the various eye muscles. Since the times when von Graefe showed that in a series of 160 cases of paralysis of the eye muscles upward of one-half of them were due to syphilis, it has been commonly stated that the origin of the ocular palsies are about equally divided between specific and non-specific causes, but since the diagnosis of syphilis has been removed from the realm of conjecture the percentage of syphilitic cases has become greater than this. In a previous paper, "Syphilis of the Brain,"[4] I said, "The frequency with which functions of the cranial nerves are disordered in syphilis of the brain has been habitually overstated by writers," and further experience has corroborated my belief. In the 790 cases upon which this study is based there was a history of diplopia in 150 cases, *i. e.*, in about 20 per cent. In only one-half of the number were there any evidences of third-nerve involvement when the patient was examined. In other words, the ocular palsies of syphilis of the nervous system are often transitory and disappear spontaneously or therapeutically. They are often the earliest symptoms of syphilitic disease of the nervous system, particularly of tabes and basilar meningitis, and of what we refer to in this paper as cerebrospinal syphilis. My experience does not lead me to agree entirely with Barnes.[5] "The ocular palsies which occur in tabes and general paralysis are in many instances permanent." Such paralyses are usually partial, transitory and amenable to treatment; in comparatively few instances permanent. In the majority of instances they are not, as formerly held, predominantly of nuclear origin.

In our statistics the third nerve showed evidence of being partially or completely paralyzed in 62 instances, and it is interesting to note that it was only affected on both sides in 5 instances. Nonne[6]

[3] Deutsch. Ztschr. f. Nervenh., xlix, 305.
[4] Jour. Am. Med. Assn., July 10, 1915.
[5] Ocular Paralysis, Birmingham Med. Rev., lxxiii, 232.
[6] Syphilis of the Nervous System, second edition, p. 206.

quotes Uhthoff as expressing the opinion that bilateral involvement of the third nerve was almost as common as unilateral, but such has not been my experience. The reason for this is probably to be sought in the fact that the bulk of the material of the Neurological Institute is what might be called acute cases. Most of the cases of bilateral ocular palsy that have been published have been cases of long standing. Of course it should not be inferred from this that bilateral palsy of the third nerve may not occur abruptly and run an acute course. As a rule syphilitic paralysis of the third nerve is not only unilateral but partial. There are many reasons for the explanation of this, but the most important of them is by no means that which has habitually been given, namely, that the nuclei of origin of the third nerve are so extensive that their blood supply is terminal and that the fibers going to make up the trunk are so incredibly numerous that few of them may be involved without implication of the remaining constituents. The real explanation is that the lymphocytic infiltration which constitutes the essential pathological lesion of syphilis of the nervous system may vary in size, intensity and extent. To any degree and in keeping with such variation will be the implication of the motor oculi nerve or other nerves of the ocular mechanism. Total paralysis of the third nerve occurred only in 10 of our cases. This experience agrees with that of Alexander, who found 19 cases of total paralysis to 145 of partial paralysis. Total paralysis is usually either the expression of gumma which causes compression of the trunk of the motor oculi nerve at some place during its intracranial transit or of an extensive basilar meningitis.

Eye-muscle paralysis may occur alone or they may occur in combination with paralysis of other cranial nerves; sometimes no involvement of the nervous system is found save an isolated ptosis or abducens palsy. Oftentimes one finds peculiar combinations of disturbances that remain after a double-sided ocular palsy; for instance, patients who are unable to look upward, and when they try to do so convergence results, and when they try to converge they cannot. Lipschutz gives the following explanations of this: In these patients there was originally complete oculomotor paralysis, so that they could neither look up nor converge. As a part of the restorative process new fibers grew out of the central stump. These new fibers did not, however, reach the muscle for which they were originally intended, they got deflected, and instead of going to the rectus inferior they went to the rectus internus. When the patient makes the effort to look upward the impulse goes through the internus instead of the inferior. This interpretation of Lipschutz seems to have been accepted in a way by ophthalmologists. But it is not characteristic of syphilitic lesions. It may occur in any disease that destroys the roots of the nerve while the nuclei are preserved.

William G. Spiller has recorded[7] a case of bilateral oculomotor palsy developing after an apoplectic attack, syphilitic in origin, implicating all the muscles supplied by the third nerve in each eye. There was no implication of other cranial nerves except the optic. The occurrence of this paralysis had been preceded by a delirious state which had many features of an alcoholic delirium. He had a fall, striking the back of the head, nine years previous to the development of the eye paralysis, and two or three months after the fall he had a convulsion. At that time the pupils were Argyll-Robertson, and there was an absent left patella jerk; the oculomotor palsies were detected six weeks before he died. On autopsy it was found that the ophthalmoplegia was caused by thrombotic closure of the small arteries supplying the portion of the oculomotor nuclei near to the pons, a bilateral softening of two separate lesions confined to the nuclei of these nerves. In every case of eye-muscle paralysis, it matters not its mode of onset or its association, syphilis must be considered. It must likewise not be forgotten that even with a positive Wassermann the cause of the palsy may not be lues but tuberculosis or sinus disease. To attribute any case to rheumatism, even though the serum is negative on first examination, is hazardous. The investigation should be searching before the rheumatic origin of the disease is accepted.

Diplopia often occurs early in the course of syphilis of the nervous system and frequently is associated with only one symptom, headache. The following case is illustrative:

Woman, married, aged twenty-three years, infection three months before the occurrence of headache and dizziness. After these symptoms had persisted two months she began to have diplopia.

Physical examination showed partial paralysis of the left third and the right sixth cranial nerves. Serum Wassermann, negative; cerebrospinal fluid normal. She had three intravenous injections of salvarsan, three of neosalvarsan, ten injections of salicylate of mercury and three months' administration of iodide of potassium before she recovered.

In such a case we assume that gumma or pachymeningitis existed. It would scarcely be credible that there was nuclear involvement of the third nerve on one side and of the sixth on the other.

Paralysis of the third nerve in syphilitic disease of the nervous system is not infrequently associated with disorder of the sixth nerve; very rarely with involvement of the fourth. In this series of 790 cases the sixth nerve was involved thirty-one times; it may have been involved in other instances and have been the cause of the diplopia; in these 31 instances it was affected at the time of examination. These figures constitute a far smaller percentage than those of Uhthoff, who found in 150 cases of paralysis of the

[7] Le Nevraxe, 1913, xiv, 15.

eye muscles the sixth nerve involved twenty-seven times. Of course the reason for the infrequent involvement of the sixth nerve compared with the third nerve is its protected intracranial course and its small nuclear area. When the sixth nerve was affected simultaneously with the third nerve the lesion was usually considered meningeal.

The fourth nerve is affected in cases of syphilis of the nervous system very rarely. In five instances only was any disorder of it recorded in these statistics. In one instance it was bilateral.

The ocular disorder dependent upon syphilis may, of course, have nothing to do with the nervous mechanism of the eye. For instance, in the following case:

A woman, aged forty-five years, seen July 13, 1912, luetic infection denied. Transitory hemiplegia, abrupt onset accompanied with loss of consciousness, one-half hour's duration. Hemiplegia disappeared in twenty-four hours, and she then complained of inability to see with the right eye. Examination five days later showed traces of right hemiplegia, sluggish left pupil; inability to see with the right eye in the upper half of the field and very hazy in the lower half dependent upon hemorrhage into the vitreous.

Syphilitic Infection of the Optic Nerves. The optic nerve was affected more frequently than we expected. In 95 cases of the entire number the optic nerve was found to be diseased, showing inflammation, choked disk or atrophy, neuritic or simple. Among the 20 cases of cerebral meningitis papilledema was encountered five times, and in 251 cases in which the diagnosis of cerebrospinal syphilis was made it was noted seven times; in every instance the choked disk was bilateral. It is interesting to note that in 9 of the cases diagnosticated as tabes or taboparesis there was either optic neuritis or choked disk. In only 1 case of general paresis was there atrophy of the optic nerve, and in this case the tendon-jerks were exaggerated. One of the extraordinary and inexplicable things about general paresis is that it does not cause optic atrophy. Dr. W. A. Holden, ophthalmologist to the Neurological Institute, whose experiences with neurological material is perhaps greater than any ophthalmologist in this country, states that in 100 consecutive cases of general paresis with exaggerated knee-jerks examined at Ward's Island there was not one case of change in the optic nerves.

The affection of the optic nerves in syphilis of the brain, whether it be choked disk, optic neuritis or atrophy, may be the result of increased intracranial pressure, the direct effect of the meningeal proliferation or pressure from a gumma. It may likewise be due to syphilitic disease of the brain, especially of the anterior quadrigeminal or the geniculate body.

Optic neuritis or choked disk may, of course, either recover or go into atrophy.

An illustration of optic neuritis and choked disks yielding readily to treatment:

The case of a woman, aged twenty-three years, who denied knowledge of infection but who admitted a Neisser infection, began to complain of headache three months before entering the hospital in November, 1913. Soon after the headache she complained that her eyes hurt. This she thought was due to working under very strong electric light. She maintained that she had no other symptoms, but on questioning she admitted that occasionally during the past two weeks she had had diplopia. Examination was negative except for a paresis of the left superior oblique and a papilledema with hemorrhages, elevation of two diopters in each eye in the retina and four in the disks. Laboratory examination revealed serum Wassermann positive, cerebrospinal fluid Wassermann positive, globulin positive, and cells 73. She recovered promptly under salvarsan administration.

As an example of simple optic atrophy no more typical case can be cited than that of a man, aged thirty years, who denied syphilitic infection. He had been complaining for a year of failing vision and of severe headaches coming on in the early morning. Physical examination was negative save for practically complete simple atrophy of the optic nerves in both eyes. The vessels showed possibly some slight sclerotic changes. The laboratory examination was: Serum Wassermann plus, cerebrospinal fluid plus, globulin weakly plus, Fehling's plus, cells 31, and this despite the fact that he had been under constant mercurial and salvarsan treatment for nine months before he came under my observation.

In certain cases of optic atrophy accompanying syphilis it may be assumed that the lesion is of the meninges, but the diagnosis must be made without laboratory corroboration from study of the cerebrospinal fluid. For instance, in the following case:

Male, aged fifty-four years; syphilitic infection denied. Symptoms of five years' duration enumerated in the order of their development: crick in the neck; inclination to hold himself tilted to the left; pain in the outer side of the right leg from the shoe top to the knee occurring paroxysmally; loss of dexterity of the hands; universal stiffness and emaciation; failure of eyesight; haziness of memory. Physical examination negative, save the eyes. Vision 20/50 in the right eye, recognition of movements of the hand in the left. Slight diffuse pallor of both disks, and some distance from the center of right disk there were a few black patches of choroiditis. Serum Wassermann was positive; cerebrospinal fluid was negative. He made complete recovery in about six months under vigorous salvarsan treatment. Incidentally his weight increased 70 pounds.

Involvement of the trunks of the optic nerves may take place at any part of their course, but they are most liable to be affected at the chiasm, and the changes that take place in the fields as well

as in the nerve itself are most variable. As a matter of fact we are in need of careful observations of the visual fields in cases of cerebrospinal syphilis in which the optic nerve is not grossly diseased.

There is practically no evidence upon which to base the diagnosis in many of these cases, save the positive Wassermann of the blood serum and the ophthalmoscopic picture. Nevertheless, I believe their origin in syphilis is secure and they should be subject to vigorous treatment. An illustrative case is briefly as follows:

A man, aged thirty-nine years, who denied syphilis, remarked toward the end of 1915 that his sight was blurred. This gradually grew worse until he had to give up his work, that of carpenter. He had no other symptoms. Examination of the eyes showed irregular pupils; the right larger than the left; the light reflex wanting; convergence reflex normal; mobility normal. Vision in the right eye 15/200, in the left 20/200. Fields showed concentric contraction of the upper half and obliteration of the lower half of the fields; more extensive in the left eye than in the right. The ophthalmoscope revealed simple atrophy of both disks. The serum Wassermann was strongly plus on five occasions. The cerebrospinal fluid was negative throughout. The diagnosis was meningitis, of syphilitic origin, causing compression of the chiasm. He received many injections of mercury and salvarsan, and although he maintains that he sees better, examination shows the vision to be the same.

In some instances, indeed, we are only justified in suspecting that the disease is of syphilitic origin, as for instance in an example of hemianopsia. A woman presented no history of syphilis save that she had had miscarriages repeatedly. In June, 1900, being then thirty-nine years old, she was seized with headache after returning from a funeral. This headache was indescribably severe, and everything seemed to her black and upside down for about nine days. After that she gradually got better, but noticed that she could not see objects to the left of her.

Examination showed no abnormalities of the nervous system; pupils slightly irregular in shape; the right larger than the left; the left responded sluggishly to light; and there was left absolute homonymous hemianopsia; vision is 20/30 to the side. The serum Wassermann and cerebrospinal fluid were negative. Examination of the heart revealed a loud, rough murmur replacing the first sound, occurring with greater intensity over the base of the heart, and a ringing second sound. The heart findings, the history of emotional distress followed by severe headaches and the way in which the symptoms came on lead us to suspect the diagnosis of cerebral embolism. However, it was recognized that the lesion to produce the hemianopsia must have been posterior to the optic chiasm and suspected that it was a syphilitic one. She was kept under close observation and two months later the serum Wassermann was

found to be positive. A month ago, seventeen years after the original attack, she had a left, incomplete hemiplegia, and the serum Wassermann was positive.

AMENABILITY TO TREATMENT OF THE NERVOUS DISEASE OF THE EYE DUE TO SYPHILIS. This phase of the subject must be discussed under three heads: (1) the pupils; (2) muscle paralysis; (3) diseases of optic nerve.

I have never seen an instance of disorder of the pupils caused by syphilis of the nervous system disappear spontaneously or under treatment.

Some of the muscle paralyses yield to treatment readily, others are most rebellious. The important matter is to distinguish one from the other. In a general way it may be said that the vast majority of cases of muscle paralysis associated with symptoms that justify the diagnosis of meningitis, especially those coming on abruptly, yield to treatment or recover spontaneously. On the other hand, those due to nuclear lesion (which are apt to develop insidiously) are rebellious and unamenable, but the majority of permanent ocular palsies are not of nuclear origin. Some of those that are nuclear at the end of life may have once been radicular. Some eye palsies are dependent upon destructive lesion of nerve bundles that cannot be regenerated. The longer an ocular palsy has been in existence the more unfavorable, as a rule, is the outlook. All syphilitic ocular palsies should be vigorously treated medicinally, while the blood and cerebrospinal fluid show evidence of syphilis; and after experience has shown that it is not safe to stop treatment for several months after the laboratory tests are negative.

Multiple ocular palsies indicative of diffuse lesion are quite as likely to yield to treatment as single paralysis. I have not compiled the statistics that support these statements, but such is my impression from study of the histories. Optic neuritis and choked disk unaccompanied by symptoms of increased intracranial pressure often disappear almost magically under appropriate treatment. On the other hand, we occasionally encounter cases upon which treatment has absolutely no effect and which go on to atrophy. I have never seen a case of primary atrophy yield to treatment. Nevertheless, I consider it proper to give such case treatment if there are evidences of syphilis in the blood and cerebrospinal fluid. I have seen cases of secondary atrophy improve proportionately to the disappearance of the intracranial disease, and some entirely recover.

Ophthalmologists have a unique opportunity to aid in the early detection of syphilis of the nervous system. Patients who show pupillary anomalies, particularly in size, contour and responsiveness to light, should be counselled to report to their physicians for examination of the blood serum and cerebrospinal fluid with the same seriousness as they are sent for investigation of the urine when

retinitis albuminurica is found. Finally, no case of disease of the nervous mechanism of the eye that has its origin in syphilis should be considered beyond recovery or unsuitable for treatment save primary optic atrophy that has gone on to completion.

I have never seen optic neuritis develop after the use of salvarsan such as has been described by Antonelli.[8]

WHOLE NUMBER OF CASES—790.

Tabes	270
General paresis	125
Cerebrospinal syphilis	251
Syphilitic endarteritis	28
Meningomyelitis and myelitis	38
Cerebral meningitis	20
Variously diagnosticated	37
Syphilis	21
	790

TABES—270 CASES.

Disorder of size, shape and contour of pupils	248
Loss of light reflex	223
Changes in optic nerve	39
History of diplopia	53
Third-nerve involvement when examined	21
Fourth-nerve involvement when examined	2
Sixth-nerve involvement when examined	13

GENERAL PARESIS—125 CASES.

Disorder of size, shape and contour of pupils	87
Loss of light reflex	42
Changes in optic nerve	1
History of diplopia	11
Evidence of third-nerve involvement	6
Evidence of fourth-nerve involvement	0
Evidence of sixth-nerve involvement	1

CEREBROSPINAL SYPHILIS—251 CASES.

Disorder of size, shape and contour of pupils	206
Loss of light reflex	142
Changes in optic nerve	32
Papilledema	7
History of diplopia	29
Evidence of third-nerve involvement	18
Evidence of fourth-nerve involvement	2
Evidence of sixth-nerve involvement	9

CEREBRAL VASCULAR DISEASE—28 CASES.

Disorder of size, shape and contour of pupils	22
Loss of light reflex	16
Changes in optic nerve	2
History of diplopia	4
Third-nerve involvement	2
Fourth-nerve involvement	0
Sixth-nerve involvement	1

[8] Arch. d'ophth., xxxii, 534.

MENINGOMYELITIS AND MYELITIS—38 CASES.

Disorder of size, shape and contour of pupils	30
Loss of light reflex	17
Changes in optic nerve	1
Evidence of third-nerve involvement	4
Evidence of fourth-nerve involvement	0
Evidence of sixth-nerve involvement	2

CEREBRAL MENINGITIS—20 CASES.

Disorder of size, shape and contour of pupils	20
Loss of light reflex	14
Papilledema	5
Optic atrophy	8
Third-nerve involvement	6
Fourth-nerve involvement	1
Sixth-nerve involvement	4

SYMPTOMATIC DIAGNOSIS—37 CASES.

Disorder of size, shape and contour of pupils	24
Loss of light reflex	13
Evidence of second nerve involvement	1
Evidence of third-nerve involvement	5
Evidence of fourth-nerve involvement	0
Evidence of sixth-nerve involvement	1

CARDIAC SYPHILIS.

By William Cabell Moore, B.A., M.D.,

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Syphilis has been recognized as a cause of heart disease for several centuries, and for a long time has been thought to be an important factor in the production of arteriosclerosis and aneurysm; but until recent years heart disease was not thought to be a frequent complication of syphilis, nor has the nature of syphilitic infection of the heart been correctly understood. During the last six to eight years, however, this subject has been studied more thoroughly, and medical literature has contained a great many articles pertaining to it. In the main these articles have dealt with syphilis of the aorta rather than syphilis of the heart, but, judging by Warthin's studies,[1] syphilis of the heart occurs quite as frequently, if not more frequently, than syphilis of the aorta, and it would even appear that the heart is syphilitic in every individual showing good evidence of syphilis elsewhere, and possibly in some showing no gross evidence whatever of the disease.

In 1909 Wright and Richardson[2] demonstrated the Spirocheta pallida in the aortas of 5 cases of syphilitic aortitis, in every one of which the aortic valves showed more or less well-marked fibrous

changes; in 1914 Cabot,[3] in proposing a new classification of cases with failing heart, called one of the four types "syphilitic;" in 1915 Anders[4] states that rheumatism and syphilis head the list as causes of heart disease, and that some recent investigators say syphilis is the principal factor; while more recently Warthin[5] reports that in the pathological service of the University of Michigan, from 1912 to 1914, one-third of all the autopsy cases on adults (41) showed active syphilis on microscopic examination, of which lesions were found in the heart in 88 per cent.

Formerly these cardiac lesions were supposed to belong only to the tertiary and later stages. The lesions were thought to be mainly gummata or aneurysms or some less well-defined disease. But since the discovery of the Spirocheta pallida as the cause of syphilis, and of methods of staining the spirochetes in tissue, and of the Wassermann reaction as an aid to diagnosis, it has been learned that the heart may be affected in both the secondary and tertiary stages of the disease, and that the lesions are more frequently an epicarditis, endocarditis, or myocarditis.

The spirochetes appear to have a special affinity for the heart and aorta, and are found frequently in these organs in syphilis. Reuter[6] and Benda[7] and Schmorl,[8] in Europe, first reported finding the spirochetes in the wall of the aorta in 1906 and 1907 and Wright and Richardson,[2] in this country, in 1909. Since then many others have confirmed these reports. However, Larkin and Levy[9] consider the demonstration of spirochetes in specimens of syphilitic aortitis as doubtful, and Longcope,[10] who has made a careful study of syphilitic aortitis, said several years ago that spirochetes could not be demonstrated in such lesions constantly by any means. Warthin's[5] painstaking and accurate studies and reports, however, prove conclusively that they can be so demonstrated, and in the tissues of both the heart and aorta. He reported last year finding the spirochetes or the characteristic tissue lesions in the hearts of a number of latent, active, and unsuspected cases of syphilis that came to autopsy, and thus pointed out the relative frequency of syphilis of the heart, as just mentioned. He found syphilis of the heart in 88 per cent. of syphilitics, while the aorta was found involved in only 78 per cent., which is contrary to the prevailing idea heretofore.

Warthin[11] also reported, in 1911, finding the heart wall crowded with spirochetes in congenital syphilis in nine infants and young children that came to autopsy. In eight of these syphilis was not even suspected clinically. Up to this time congenital syphilis of the heart was considered a rarity, being limited to those cases in which gumma of the heart was found; but Warthin showed that there exists a special form of diffuse interstitial myocarditis in congenital syphilis, with nothing in the gross appearance to suggest myocarditis, but with certain fibroblastic epithelioid areas of the heart wall microscopically found crowded with spirochetes. Warthin considers this

an important cause of sudden death in early life, occurring as a rule in apparently healthy children, in whom syphilis may never have been suspected clinically. In this connection Wiesner,[12] in 1905, reported finding syphilitic aortitis in congenital syphilitics, and Rach and Wiesner,[13] in 1907, found changes in the aorta in the majority of a large number of syphilitic fetuses examined; while Klotz,[14] in 1908, found lesions in the aorta, practically identical with those in the acquired disease, in a case of congenital syphilis that came to autopsy.

As to the nature of the syphilitic process in the heart, various authorities[9 10 16 17 18] practically agree that the lesion begins in all stages in the lymph spaces around the small vessels as a localized or diffuse, perivascular, small round-cell and plasma-cell infiltration, resulting in a productive inflammatory process. The evidence of these changes is plain microscopically, where there may be little or no macroscopic evidence, and the spirochetes may be found in these areas at autopsy.[5 13 19] Likewise, this process can be differentiated histologically from the simple degenerative process in atherosclerosis.[9 15]

The lesion may be situated in the epicardium, the endocardium, or the myocardium, but is more frequently found in the myocardium. In a series of 50 cases that came to autopsy, reported by Brooks[16] in 1913, the myocardium was diseased in 44 cases and the epicardium in 28, disease of the coronaries occurred in 35, and there was cardiac gumma in 5. Brooks does not mention the number in which endocarditis was present, but syphilitic endocarditis is known to occur frequently, and syphilis is such a well-known factor in the production of aortic endocarditis that it is to be suspected strongly in any case of aortic insufficiency. This is the most frequently encountered syphilitic valvular lesion, and occurring without involvement of any other valve, especially in patients under fifty, is extremely suggestive of syphilitic origin. Longcope,[10] basing his deductions upon a series of autopsy cases, found that 81.5 per cent. of cases of uncomplicated aortic insufficiency were probably syphilitic, and Larkin and Levy[9] state that pure aortic insufficiency is undoubtedly of syphilitic origin except in cases of infective endocarditis. When the aortic lesion is associated with a lesion of the mitral or of other valves, syphilis is less likely to be the cause, the probable origin being an infective or atheromatous process; but syphilis should be suspected until disproved. Longcope[20] has reported 2 cases of aortic insufficiency associated with disease of the mitral valves in which the Wassermann reaction was positive, but he states that spirochetes were not found in the mitral valves, and therefore the mitral lesion was not proved positively to be syphilitic.

Aortic insufficiency is also often associated with aortitis and sometimes with aneurysm of the arch of the aorta, both frequently the result of syphilis. Wright and Richardson[2] found involvement of

the aortic valve in the 5 cases in which they found spirochetes in the aorta; Larkin and Levy[9] state that an insufficient aortic valve is the most common complication of syphilitic aortitis, and Longcope[10] has frequently found the two associated, the general impression being that the valvular lesion is an extension from the aortitis. Longcope[12] found 4 cases of aneurysm in 43 cases of aortic insufficiency, and a similar case was seen by me within the past month at the George Washington Hospital Dispensary: A colored woman, aged twenty-eight years, with the physical signs of aortic insufficiency, and a broad supracardiac area of dulness which the fluoroscope showed to be a pulsating and expansile mass. She had a strongly positive Wassermann.

Also, lesions of other valves than the aortic are sometimes found associated with aortitis, or with aneurysm of the arch, in patients with a positive Wassermann and other evidences of syphilis, who do not give a history of rheumatism or other infection, except syphilis, that might produce endocarditis. Two such cases have been seen by me recently. In one, seen in the George Washington Hospital Dispensary, there were the signs of mitral stenosis and of aortitis in a woman, aged thirty-one years, who had a positive Wassermann and syphilitic sores in the mouth. In the other, seen in the hospital wards, there was a pulmonary stenosis associated with a beginning aortitis in a syphilitic, in whom the valvular lesion appeared to be the result of an acute endocarditis, and therefore of recent origin. If so the inference is that it was due to syphilis, though there was no absolutely definite evidence to this effect. This patient was seen by other observers, all of whom concurred in the diagnosis of pulmonary stenosis. Pulmonary stenosis is found so rarely in acquired cardiac disease that this case should be of sufficient interest to be reported briefly.

Case Report.—H. H., aged twenty-eight years; white; male; married; cashier in a restaurant. This patient was sent in by Dr. Kane because of fever, headache, vertigo and nausea setting in suddenly three days before. His family history and personal history were negative. He denied syphilitic infection, but his Wassermann was four plus and Noguchi two plus. He had been married nine months and his wife had become pregnant once, resulting in a miscarriage. His temperature was irregular, ranging the first three days from 97.6° to 104.6°; the next two weeks from 98° to 101°; and then for four days from 98° to 100°, which it was when he left the hospital. Examination disclosed nothing to account for the fever other than the cardiac findings and the positive Wassermann. There was no throat or joint involvement that could be made out, nor history of any at a previous time. The cardiac impulse was in the fifth left interspace, 11 cm. from the midsternum, and the R. C. D. extended 12 cm. to the left and 3 cm. to the right of the midline. There was an area of retromanubrial dulness extending

5 cm. to the left and 2 cm. to the right in the first interspace, and 3.5 cm. to the left and 2 cm. to the right in the second interspace. There was a marked systolic thrill felt in the first, second and third spaces to the left of the sternum, most marked in the first. A soft systolic murmur was heard at the apex and transmitted faintly to the axilla; a loud, long, and coarse systolic murmur was heard over the left base, loudest in the first left space, also a faint systolic murmur was heard in the aortic space and in the neck. These murmurs and the thrill were scarcely recognizable at the first examination, later increased in intensity, and varied much in intensity from time to time. The aortic second was distinct, the pulmonic second faint. The blood-pressure was 124 systolic and 64 diastolic in the left arm and 126 systolic and 58 diastolic in the right arm (Tycos). The pulse was regular in force and frequency, 64 to 100, generally between 80 and 90. There was no tracheal tug and pulsation in the radials was synchronous. The blood, on admission, showed 80 per cent. hemoglobin, 4,200,000 red cells, and 8900 leukocytes; 65 per cent. polymorphonuclear neutrophiles and 4 per cent. eosinophiles, 10 per cent. small and 20 per cent. large lymphocytes, and 1 per cent. transitionals. One week later there were 11,200 leukocytes. The Widal was negative and the malarial parasite was not seen in four examinations. A roentgen ray by Dr. J. H. Selby showed an area of increased density in the first and second spaces, comparing accurately with the area of dulness in this region, and the fluoroscope showed no expansile tumor. He was given one deep injection of salicylate of mercury, which produced salivation promptly, and two doses of salvarsan, but did not seem to be particularly benefited. He left the hospital at his own request, and, unfortunately, has been lost sight of.

The time at which the heart lesion becomes manifest varies and cannot always be determined, but Brooks[16] states that serious involvement of the heart may begin before or with the secondary stage, and that lesions in the heart frequently appear early. In one case in Brook's series death resulted from a minute perforation of the aorta just above the ring before the secondary rash had fully appeared and before the diagnosis had been made. Other instances of early cardiac syphilis have been recorded, but not many. In this connection I wish to mention a case recently seen by me:

A young man, aged twenty-four years, referred by Dr. Garnett for examination because of precordial pain of a few days' duration, had a temperature of 99.6° and a pulse rate of 110, a slightly enlarged area of cardiac dulness, an occasional extrasystole and a soft systolic murmur at the base. There was a beginning macular eruption over his body, which he had not noticed until it was pointed out to him at that time. He denied knowledge of luetic infection, but acknowledged possible exposure to infection. His Wassermann was strongly positive. Since getting antiluetic treatment his

cardiac symptoms have subsided. Therefore this would appear to be a case of syphilis with cardiac involvement occurring early in the secondary stage.

The cardiac involvement is not often recognized at this early stage, however. The majority of cases of cardiac syphilis are discovered at a later period, owing, probably, to the fact that the symptoms of cardiac syphilis in the early stages are not very definite, and to the fact that the relation between such cardiac symptoms and syphilis is not generally understood. Possibly, too, though infection of the heart occurs early, the process may remain latent for years.

Precordial pain, palpitation, dyspnea, tachycardia, with intermittence, extrasystole or other disturbance of rhythm, more marked on slight exertion, together with a soft systolic murmur at the apex, are very suggestive of cardiac involvement even when history of the infection is denied. Grassman,[21] in his study of the vascular system of 288 cases of secondary syphilis, states that in 85 per cent. there were disturbances in the rate and rhythm of the pulse, while accidental murmurs, usually with dilatation of the heart, occurred in 40 per cent. With the secondary stage, in addition to the symptoms directly referable to the heart, there also are symptoms of a mildly acute infectious disease, slight fever with a moderate leukocytosis often and a relative polymorphonuclear increase. Later in the disease, after a longer cardiac involvement, the earlier cardiac symptoms having been overlooked possibly, the symptoms are those of an acute or more usually a chronic endocarditis, generally of the aortic valve; or of myocarditis; or of angina, due possibly to partial occlusion of the coronary arteries; or of heart-block.

The diagnosis will depend upon these signs and symptoms of some cardiac disorder, together with the history, the general aspects of the case, the Wassermann, and the response to specific medication. Possibly the most important single element is a positive Wassermann. In a study of 36 cases of aortic disease, in 1912, Cummer and Dexter[22] found a positive Wassermann in 27, or 75 per cent.; and out of 47 cases examined by Longcope[10] 35, or 74.4 per cent., gave a positive reaction. Seven of these positive cases came to autopsy, and all showed typical mesaortitis with involvement of the aortic ring, while in 3 spirochetes were found in the wall of the aorta. Larkin and Levy[9] state that 94 per cent. of individuals with luetic aortitis give a positive Wassermann. Similar reports are to be found, the percentage of positive Wassermanns being variously given. Longcope,[10] in summing the matter up, gives from 25 to 68 per cent. positive in general cardiovascular disease, from 75 to 80 per cent. positive in aortic insufficiency, from 85 to 95 per cent. positive in aneurysm, and from 75 to 88 per cent. positive in aortic disease in general. As stated before, the signs of aortic indufficiency, unassociated with other valvular lesions, in an individual under fifty are practically pathognomonic of cardiac syphilis, when

infective endocarditis can be excluded; and the association of any valvular lesion with an aortitis or an aneurysm of the arch of the aorta in a person with a positive Wassermann, in whom rheumatism can be excluded, is, to my mind, to be looked upon with great suspicion. Anginal attacks suggest disease of the coronaries or cardiac aneurysm, and the possibility of syphilitic etiology in this event, especially in persons under fifty, should be carefully investigated. The so-called cardiac crises in tabes are probably anginal attacks from coronary disease, so frequently the result of syphilitic infection of these vessels. Warthin[5] believes that the heart and aorta of every latent syphilitic are involved, and that syphilis will be found to be the principal factor in the production of myocardial insufficiency and the cardiovascular renal complex. From his studies it is to be inferred that when syphilitic aortitis exists there exists also syphilitic involvement of the heart, and, also, contrary to the general impression, that the cardiac lesion is not necessarily incidental to the aortitis. This aortitis may be recognized by increased retromanubrial dulness, a broad roentgenographic shadow in this region, possibly increased systolic blood-pressure, a systolic murmur at the base transmitted to the neck as a rule, and a positive Wassermann.

A cure of cardiac syphilis is hardly to be expected under any circumstances, but an amelioration of the symptoms and a prolongation of life in comparative comfort may be expected when proper treatment is instituted early. Even in late cases proper treatment will do much good, but after cardiac decompensation has set in it is unusual for any treatment to do more than slight good, and such cases usually end fatally within a comparatively short time. There were 2 cases with decompensation in the George Washington University Hospital wards recently. One derived no benefit from any treatment and ended fatally in a short time; the other improved somewhat under rest, digitalis, mercury, and salvarsan, and left the hospital, but was never able to return to work, and has again more recently returned to the hospital for further treatment. Brooks and Carroll[17] state that when treatment has been interrupted, as in this instance, and is later resumed again, one rarely gets as prompt and satisfactory a response. This observation is exemplified in this patient.

Treatment of cardiac syphilis should be mainly antisyphilitic and intensive. It should differ but little, if at all, from the treatment of syphilis generally, except in so far as the cardiac involvement may be seen to be affecting the patient. The principal object should be to destroy the spirochetes in the tissues as quickly and as effectively as possible, and therefore antisyphilitic treatment should be pushed to the limit of tolerance. As to specific medication, there can be no cut-and-dried rules that will apply to all cases. Each case must be treated individually. Mercury by deep injection, preferably

one of the soluble salts, and salvarsan intravenously are both to be used. There appears to be but little choice between the old and the new salvarsan, but personally, from a rather limited observation, I am inclined to prefer the old. There is some question as to the use of salvarsan in acute endocarditis, but used in small dose often repeated, rather than in full dose, I believe it to be safe. The iodides are apparently of no use in the early cases, though possibly helpful in old lesions. Improvement is prompt, as a rule, in all cases, though, of course, more marked in early cases, and cardiac decompensation always offers a poor prognosis. In the early cases the patients must avoid cardiac strain until their cardiac symptoms are in abeyance; otherwise cardiac treatment is not indicated. In long-standing cases, when circulatory disturbance is more marked, improvement often takes place promptly under specific treatment alone, but, as a rule, it is almost always advisable also to place these patients under the usual hygienic and therapeutic treatment indicated by the circulatory condition, mainly rest and digitalis.

According to Brooks and Carroll, Anders and others treatment should be continued for at least one year after all signs of activity have subsided, and, irrespective of a negative or a positive Wassermann, antispecifics should be administered from time to time throughout life.

CONCLUSIONS. Cardiac complications during syphilis occur much more frequently than has been recognized generally heretofore.

The cardiac lesions occur earlier in the disease than has been thought, even in the early secondary stage.

Congenital syphilis of the heart is a cause of sudden death in early life, this condition being unsuspected clinically, as a rule.

The nature of the process in the heart is distinct and may be recognized microscopically, and the spirochetes may be found in the lesion; it is most frequently a myocarditis. Uncomplicated aortic insufficiency is of syphilitic origin in the majority of instances.

The symptoms are not definite but extremely suggestive; the diagnosis depends mainly upon the signs of some cardiac disorder, with a positive Wassermann, and a response to antiluetic treatment.

The prognosis is good in the early stages and varies directly with the stage of the disease and the extent of the changes produced.

Treatment should be mainly antisyphilitic and intensive. Cardiac treatment is required rarely except in cases with decompensation. Once instituted treatment should be carried through persistently and uninterruptedly.

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SULPHOCONJUGATION AS A TEST OF LIVER FUNCTION.

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Of the various functions of the liver, its detoxicating influence is one of the most important, and one also, to which very much attention has been devoted. It is quite well known that toxic radicals liberated during the process of normal or abnormal intestinal digestion are carried to the liver by means of the portal circulation, and there either neutralized or oxidized or conjugated, etc., to lessen or remove the toxic influence of the substance. One of these methods of detoxication is the union of aromatic radicals with sulphuric acid and their excretion in the form of conjugated sulphates (ethereal sulphates) in the urine.

Since Städeler found phenol in cows' and horses' urine, Landolt, Lieben, Hoppe-Seyler, Buliginsky, and Munk found traces of it in normal human urine, and Salkowski observed that in ileus and other obstructive intestinal disease the excretion of phenol in the urine is much increased.

This formation of phenol and phenolic substances, cresol, indol, skatol, etc., has been ascribed to the action of intestinal bacterial flora. Such organism like the B. coli communis, which is a normal inhabitant of the intestinal canal, are harmless under ordinary circumstances. In conditions of injury to the intestinal mucosa these organisms become virulent (Fermi and Salto). Other organisms, like the B. putrificus, the B. aërogenes capsulatus, which are obligatory anaërobes, thrive in the colon when there is no oxygen (Herter) and break up protein into the carbocyclic, toxic substances.

It was demonstrated by Baumann that these split products are very toxic, but that when they are united with sulphuric acid they have lost their poisonous effect. Baumann found that phenol sulphate is a normal urinary constituent and that the administration of phenol increases the elimination of phenol sulphate in the urine. Baumann and Herter reported that not only phenol, but also other substances were excreted in the urine as conjugated sulphates. They also observed that phenol unites not only with sulphuric acid but also with other radicals. This was confirmed by Schmiedeberg, who found that phenol unites with glycuronic acid. Upon poisoning dogs with phenol, Baumann found that the liver became rich in phenol sulphates. For example, in 100 parts of liver he found nineteen times as much tribromphenol as in 100 parts of blood. This observation seemed to prove that the liver is the seat of conjugation of phenolic and indolic radicals with sulphuric acid. The results of other scientists were, however, contradictory, as will be seen from the following references:

Lang determined the quantity of ethereal sulphates in the urine of geese before and after extirpation of the liver. Though his analytical differences are rather small, and should not be taken conclusively, still he was led to believe that the synthesis of the ethereal sulphates was not exclusively performed in the liver.

In experiments performed *in vitro* Kochs also demonstrated, so it appeared to him, that the liver was not the only seat of sulphoconjugation. He took portions of liver, kidney, pancreas, thymus, muscles, and minced each organ respectively and added phenol and disodium sulphate. He kept these mixtures at body temperature or else at 8° to 12° C. He reported that all the tissues save the thymus took part in the synthesis. He obtained the same results with ortho-, meta-, and para-dioxyphenol.

Landi repeated the experiments of Kochs, using, however, only liver tissue. But, as he says, due to the fact that the decomposition sets in so very soon, he could not confirm Kochs' findings. In order to throw more light on the subject he made perfusion experiments with the liver, and he came to the final conclusion that the seat of conjugation of the phenolic and sulphuric acid radicals was not the liver but the intestines.

The observations of Landi found no confirmation and were directly contradicted by the results of Embden and Glaessner. They performed perfusion experiments on the organs of dogs, using the liver, kidneys, muscle, lungs, and small intestines. From their investigations they concluded that the liver was the most important organ for the formation of the ethereal sulphates. Smaller quantities of ethereal sulphates are produced in the lungs and the kidneys, but the muscle tissue and the small intestine play a very insignificant role in the production of the ethereal sulphates. Reale, from his observations, was firmly convinced that the liver was the seat of the synthesis of the conjugated ethereal sulphates.

In normal conditions of the alimentary tract, Strauss and Philipsohn found no phenol in the urine of human beings, and they concluded that under normal conditions the phenol and other radicals were conjugated with sulphuric acid. According to these authors the liver is the seat of this conjugation.

Herter and Wakeman took 7 grams of liver, kidney, muscle, brain, and blood respectively, which they minced, and treated each tissue with 10 c.c. of a weak phenol solution, and allowed to stand for two to three hours. The mixtures were then distilled, and they found that there was a loss in the phenol distilled over. The liver retained most of the phenol, then came in order the kidneys, muscle, and brain.

In hepatic disease there have been observed disturbances in the elimination of the ethereal sulphates. In conditions of jaundice Biernacki found four times as much ethereal sulphates as normally. Darenberg and Perroy found an increased excretion of indol and skatol in the urine of jaundiced individuals. Labbe and Vitry obtained similar results. Magrageas obtained varying amounts of ethereal sulphates in icteric patients.

The question has been discussed by Eiger and Hopazde whether the aromatic compounds formed in the system are diminished in amount and destroyed under normal conditions of hepatic activity, and whether in cases of disturbances of the function of the liver, these compounds are obviously increased and placed at the disposal of the liver for conjugation with sulphuric acid. The subject is important in its relation to cases of disease of the hepatic parenchyma, more so than in cases of simple biliary stasis. The ethereal sulphuric acids are most frequently, both absolutely and relatively, increased in atrophic cirrhosis of the liver, and most markedly in tumors of the liver.

Finizio studied the excretion of ethereal sulphates in normal individuals, in a patient suffering with an echinococcus cyst of the liver, and in cases of hepatic cirrhosis. He found that when he administered thymol to the normal or echinococcic individual there was a marked increase in the ethereal sulphate output in the urine, whereas the cirrhosis patient showed no such increase.

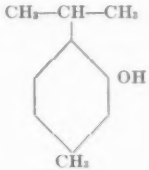
It has been quite definitely established that normally the inorganic sulphates of the urine form about 70 per cent. of the total sulphur and the remaining 30 per cent. are divided almost equally between the ethereal sulphates and the neutral sulphur.

It is, of course, impossible to rely upon the excretion of ethereal sulphates as an index of hepatic function. The proteins that are ingested daily give rise to their quota of aromatic radicals which influence the quantity of the conjugated sulphates excreted.

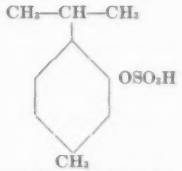
It has seemed to me advisable, therefore, to administer a definite quantity of an aryl compound and to examine the urine for the conjugated products of this substance. For the purposes of

this work thymol seems to be the most suitable aromatic substance to use.

Thymol is meta-isopropyl-cresol. Baumann and Herter have found that thymol sulphuric acid occurs in the urine of rabbits after thymol administration. Vogelius reported that the feeding of 0.5 gram thymol increases the output of ethereal sulphates from 0.05 gram to 0.107 gram per 100 c.c. of urine. Blum, Preusse and Finizio have separately reported that thymol is eliminated in the urine as thymol sulphuric acid and as thymol hydroquinone sulphuric acid.



Thymol.



Thymol sulphuric acid.

I adopted the following technic for the determination of hepatic sufficiency by means of the ethereal sulphate output.

The patient received a dose of castor oil to clean out his bowels. He was then kept on a known diet for two days, during which time the urine was collected, preserved with a few drops of formaldehyde, and analyzed for total sulphur and ethereal sulphates.[1] On the third day the patient received a capsule containing 0.5 gram thymol. A dose of olive oil is administered to the patient several hours after the thymol dose in order to dissolve the thymol and increase its absorption from the intestinal canal. The urine was collected for the next forty-eight hours, preserved with a little formaldehyde and analyzed for total sulphur and the ethereal sulphates.

If all the thymol were absorbed and if all the thymol were conjugated with sulphuric acid and none with glycuronic acid the 0.5 gram thymol would be excreted as 0.7666 gram thymol sulphuric acid. This would cause a marked increase in the percentage of the ethereal sulphates. If the liver were not functionating properly the thymol would not be conjugated and the percentage of ethereal sulphates would be only slightly different from what it had been on the first two days.

It is probable that each individual cell of the hepatic parenchyma takes part in all of the liver functions; it is possible, however, that different portions of the liver lobule may have specific functions. In the former case it is most likely that a reduction in the ability of the liver to perform one function will be accompanied by a proportional reduction in all the liver functions; in the latter case one or

[1] The total sulphur was analyzed by Benedict's method, and the ethereal sulphates by Folin's method.

more functions of the liver may be disturbed without affecting the other hepatic functions. One objection to the study of the function of any organ as an index of disease of that organ is that it is perhaps possible for the healthy portion of the diseased organ to compensate and assume the work of the whole gland. In such a condition, of course, the functional capacity of the organ may be normal and would be no index of the pathological changes in that organ. Under these circumstances only marked destructive changes would leave their impress on the functional sufficiency of the organ.

ETHEREAL SULPHATE ELIMINATION BEFORE AND AFTER THYMOL ADMINISTRATION.

Case No.	Diagnosis.	Total sulphur, gms.		Ethereal sulphate sulphur, gms.		Ethereal sulphate sulphur, per cent.	
		Before thymol.	After thymol.	Before thymol.	After thymol.	Before thymol.	After thymol.
1	Normal	2.0375	2.1295	0.2893	0.5646	14.2	26.8
2	Gastritis	1.9428	1.7427	0.1457	0.3380	7.5	19.4
3	Fracture	2.7467	2.5527	0.3131	0.6024	11.4	23.6
4	Congestion of liver	0.9852	0.0734	0.1753	0.7069	17.8	26.8
5	Congestion of liver	1.7345	1.6982	0.2480	0.3610	14.3	21.2
6	Gall-stones	2.7628	2.8075	0.7597	1.0303	27.5	36.7
7	Gall-stones	3.0042	2.6826	0.3965	0.8474	13.2	29.4
8	Cholecystitis	2.7807	2.6437	0.4866	0.7428	17.5	28.1
9	Atrophic cirrhosis	2.2328	2.3029	0.2791	0.3400	12.5	15.2
10	Tumor of liver	1.9492	1.8757	0.1637	0.3676	8.4	19.6
11	Cancer of liver	2.7526	2.6278	0.6083	0.6648	22.1	25.3
12	Syphilis of liver	2.8104	2.9075	0.3990	0.5437	14.2	18.7

The results that we have obtained in the cases cited in the accompanying table are very encouraging. The work is now in progress. We are collecting comparative data as to the positive incidence of this test and other tests of liver sufficiency in the same case of hepatic disease.

SOME CLINICAL AND EXPERIMENTAL OBSERVATIONS ON GASTRIC ACIDITY USE OF THE GAS-CHAIN METHOD.

By Golder L. McWhorter, M.D., Ph.D.,
CHICAGO.

(From the Department of Surgery, University of Minnesota.)

In order to determine the effect produced by chronic inflammatory and altered physiological changes in the gastro-intestinal tract, I have undertaken the study of the gastric secretion in such conditions by means of the exact gas-chain method of determining the acidity and have plotted curves, comparing the results with those gained by

the titration method. Previous to this time acidity curves have been made clinically only by the titration method. My estimations were made from specimens collected at short intervals after test meals in clinical cases and in animal experiments. In order to obtain pure juice in the latter experiments Pawlow pouches were made and estimations of secretion carried on before and after the production of lesions or altered physiological conditions. In such surgical conditions there may be an increased acidity in the stomach contents; in these observations I have attempted to determine whether such an increase is due to an actual increased acidity in the gastric juice.

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A solution is acid in reaction when it contains an excess of hydrogen over hydroxyl ions, neutral when they are in equal numbers and alkaline when hydroxyl ions predominate. Pure distilled water dissociates into hydrogen and hydroxyl ions, the extent of the dissociation being such that in one liter of water at 22° C. there is approximately $\frac{1}{10000000}$ gram of hydrogen ions; that is, concentration of the hydrogen ions is $\frac{1}{10000000}$ normal (atomic weight of hydrogen as 1). The shorter method of representing so many figures is usually adopted, the logarithmic notation: thus, $\frac{1}{10000000}$ H. Acid $= 10^{-7}$ or simply pH 7. Since there is one hydroxyl ion formed for each hydrogen ion the concentration of the hydroxyl ions must also equal pH 7.

The measurement of the pure gastric juice has been made by Menten,[3] and found to vary from pH = 0.92 to 1.58, highest in the appetite juice and lowest in the secretion in the empty stomach. Michaelis and Davidsohn[4] state that the average acidity of the stomach contents after an Ewald test meal means 0.028 to 0.0015; hyperacidity, 0.011 to 0.088; hypoacidity, 0.000,0041 to 0.000,0001. McClendon,[5] after normal meals, found a rise in acidity for two or

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more functions of the liver may be disturbed without affecting the other hepatic functions. One objection to the study of the function of any organ as an index of disease of that organ is that it is perhaps possible for the healthy portion of the diseased organ to compensate and assume the work of the whole gland. In such a condition, of course, the functional capacity of the organ may be normal and would be no index of the pathological changes in that organ. Under these circumstances only marked destructive changes would leave their impress on the functional sufficiency of the organ.

ETHEREAL SULPHATE ELIMINATION BEFORE AND AFTER THYMOL ADMINISTRATION.

Case No.	Diagnosis.	Total sulphur, gms.		Ethereal sulphate sulphur, gms.		Ethereal sulphate sulphur, per cent.	
		Before thymol.	After thymol.	Before thymol.	After thymol.	Before thymol.	After thymol.
1	Normal	2.0375	2.1295	0.2893	0.5646	14.2	26.8
2	Gastritis	1.9428	1.7427	0.1457	0.3380	7.5	19.4
3	Fracture	2.7467	2.5527	0.3131	0.6024	11.4	23.6
4	Congestion of liver	0.9852	0.0734	0.1753	0.7069	17.8	26.8
5	Congestion of liver	1.7345	1.6982	0.2480	0.3610	14.3	21.2
6	Gall-stones	2.7628	2.8075	0.7597	1.0303	27.5	36.7
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three hours, when it remained constant until the food had left the stomach. Carlson[6] believes that the view of Pawlow[7] that gastric juice is secreted at uniform and constant acidity is true for man only in regard to the appetite, digestive and hunger juice secreted at a fairly high rate, and has observed that the normal gastric mucosa is capable of secreting a juice of submaximal acidity. Hardt[8] after experimental production of gastric and duodenal ulcers found no increased acidity. Grey[9] after cholecystogastrostomy found no change in the acidity of the gastric secretions.

Pawlow believes that the slower rate of secretion may give a chance for the HCl acid to be partly neutralized by the mucus in the stomach. Boldyreff[10] has shown the entrance of the intestinal contents to be the most important factor in neutralization of the stomach contents.

For the purpose of comparison of acidity estimations a standard test meal was adopted which consisted of two slices of bread with crusts removed and two glasses of distilled water. In all estimations the Rehfuss[11] tube was used for collecting specimens. Collections were made every fifteen minutes from the time the test meal was eaten until no more material could be aspirated. Unfiltered gastric juice was used in the estimations, though at times it was strained through coarse gauze. In order to compare the actual acidity to the acidity obtained by the usual titration methods, samples of the juice were titrated against a $\frac{N}{5^0}$ KOH solution, using dimethyl amino azobenzene and phenolphthalein as indicators. I have found that the value of these indicators used clinically in determining free and total acidity by titration with an alkali is in many cases parallel, though not equivalent, to the actual acidity as determined by the gas-chain method (Fig. 1). Much discussion has arisen as regards the value of the titration methods; consequently, I have made observations by both methods, and have plotted, also, corresponding curves to compare the values of the dimethyl amino azobenzene acidity to the actual acidity. Fig. 1 shows the curves running fairly constantly parallel throughout; however, the acidity as determined by the "indicator method" is uniformly higher than the actual acidity. Fig. 2 shows the plate for determining the hydrogen ion concentration from the dimethyl and phenolphthalein acidity as

[6] The Secretion of Gastric Juice in Man, Am. Jour. Physiol., 1915, xxxvii, 51. A Note on the Chemistry of Normal Human Gastric Juice, Am. Jour. Physiol., 1915, xxxviii, 248.

[7] The Work of the Digestive Glands, 1910, translated by Thompson.

[8] The Secretion of Gastric Juice in Cases of Gastric and Duodenal Ulcers, Am. Jour. Physiol., 1916, xl, 314.

[9] Jour. Exper. Med., 1916, xxiii, 15.

[10] Self-regulation of Acidity of Gastric Contents and Real Acidity of Gastric Juice, Quarterly Jour. Exper. Physiol., 1914, vii, 1–12.

[11] A New Method of Gastric Testing, with a Description of a Method for Fractional Testing of Gastric Juice, Am. Jour. Med. Sc., 1914, cxlvii, 848.

determined with the above indicators. This assumes the acidity to be in terms of pure HCl acid, which dissociates, as shown by the

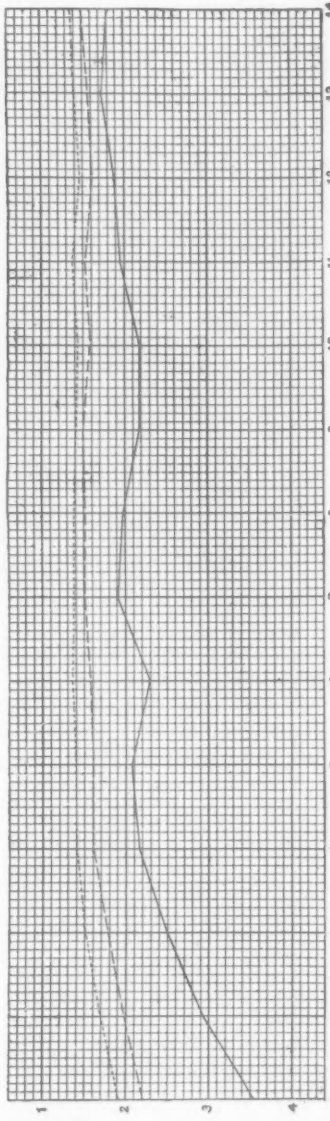

FIG. 1.—The lower solid line is a composite of 32 acidity curves in groups I and II by the use of the gas-chain method of determining the pH. The broken line represents a composite curve of the pH derived from the dimethyl amino azobenzene acidity, assuming it to be pure HCl. The dotted line in the same way represents the phenolphthalein acidity. The estimations were made from specimens collected at fifteen-minute intervals.

curve. Fraenkel[12] found the Congo-red acidity to be almost constantly parallel to the actual acidity as determined by the gas-chain method, and states that the phenolphthalein acidity does not show the free HCl acid even in the pure gastric juice.

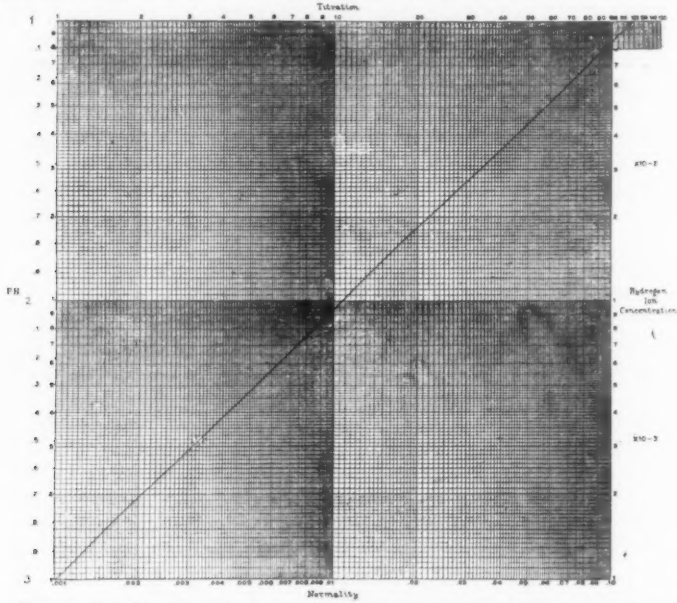

FIG. 2.—By this chart the degree of dissociation of HCl at different degrees of strength may be determined and either the hydrogen ion concentration or the pH estimated. The curve continued from 120 c.c. N/10 HCl = pH 1 would show the dissociation of HCl at higher concentrations. 130 c.c. N/10 HCl = pH 0.996; 140 c.c. N/10 HCl = pH 0.993; 150 c.c. N/10 HCl = pH 0.9. (Chart plotted for me by J. F. McClendon.)

The plotted curve of acidity of 37 cases may be divided into several phases for study: (1) the ascension, usually the first hour, indicating the rapidity and intensity to a known stimulus; (2) the high point or acme, to note whether accelerated or retarded and whether abrupt or sustained; (3) the period of descent or decline and the possible secondary rise, also to note the character and modification of the food residues. The cases observed include chronic appendix and gall-bladder cases, before and after operation, hernia, carcinoma of the stomach, kidney stone, huge ovarian cyst, gastrojejunostomy, duodenal ulcer, prostatic hypertrophy and a few remote surgical conditions.

In Group I, 10 of 13 cases tend to a gradual rise, and at the end of the first hour have reached the maximum from which they usually

[12] Die Wasserstoff- Ionenconcentration des reinen Magensaften und ihre Beziehungen zur elektrischen Leitfuhigkeit und zur titrimetrischenaciditat., Ztschr. Exper. Path. u. Therap., i, 431, 1905.

decline gradually. Three cases have a delayed rise. The average time juice could be obtained was two and a half hours, food being absent in the last fifteen minutes to three-quarters of an hour.

In Group II the curve either remains continuously high, or after a fall, undergoes a second rise, often higher than the primary one, near or at the end of digestion. In this first subdivision are 6 cases, 2 of which have a delayed rise; in the second subdivision are 12 cases, 1 having a delayed rise. The average time specimens could be obtained in the first division of Group II was two hours; in the second, two and three-quarter hours; in one-half of these cases food was present to the end.

In Group III, I have placed 5 cases of hypoacidity in which the acidity was less than pH = 4. Michaelis and Davidsohn place hypoacidity between 0.00041 and 0.0000001. Considerable peptic digestion takes place at pH = 4 and very rapid digestion at pH = 0.78 (Sorensen[1]), so that digestion is retarded but not stopped until acidity is less than pH = 4. Dimethyl amino azobenzene does not react to an acidity less than about a pH of 4. In one of these cases the curve of acidity later, after removal of a gall-bladder with stones, rose to a normal acidity curve. The average time specimens could be obtained in this group was two and three-quarter hours.

Hypersecretion was demonstrated in gastric ulcer cases thirty years ago (Rubow). Recently it has been found not only in inflammatory conditions of the gall-bladder, appendix and in pelvic and other organs but in normal individuals. The vagus is considered one factor in producing this condition.

The values of pH before operation were taken in 8 cases with chronic appendicitis and a composite curve plotted (Fig. 3). The curve gradually rises to the end of the first one and a half hours, then falls slightly to the two-and-a-half-hour period, when it begins a secondary rise higher than the digestive rise, lasting to the end of collection. Two of these cases, having definite gastric disturbances, had early high acidity with an exaggerated secondary rise. Secretion in these chronic appendix cases was obtained for an average of two and three-quarter hours, but was obtained longer in the 2 cases with definite gastric symptoms. Food was present in 3 cases without symptoms to the end of observation, but in the others it was absent in the last three-quarters of an hour.

In addition to cases studied by the fractional method I ran a series of 14 clinical cases, comparing the secretion obtained one hour after an Ewald meal before and after operation for chronic appendicitis. I estimated the titration acidity in all of these cases, the total chlorides in 5 and determined the pH in 9 cases. There was some variation in the pH but no constant change after operation; therefore these results are not tabulated.

A composite curve of 7 cases of gall-bladder disease was plotted (Fig. 3). On account of variations in the individual acidity an irregular curve was formed. The curve rises rather suddenly in the

first three-quarter hour, then falls in an irregular wave to the two and a fourth hour period, when it begins its secondary rise higher than the digestive rise and retains it to the end of collection. Secretion was obtained in these cases an average of only a little over two

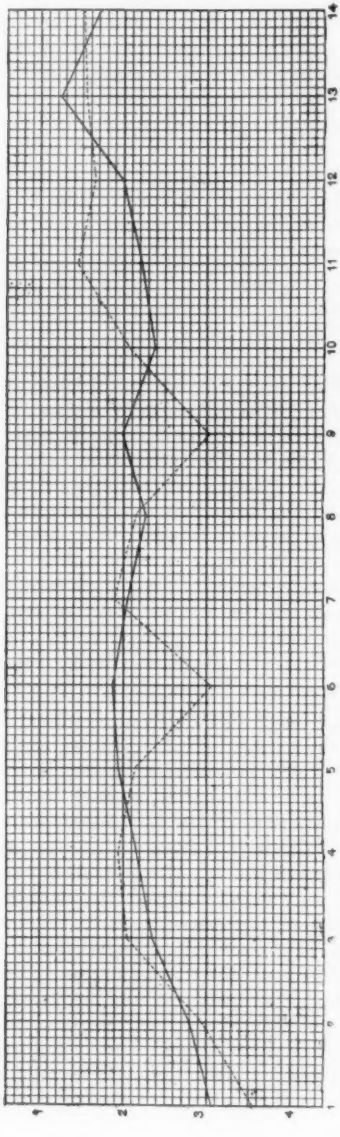

FIG. 3.—The solid line represents a composite of eight acidity curves in chronic appendicitis. The broken line represents a composite of the gall-bladder acidity curves. Both of the acidity curves are in terms of pH as determined by the gas-chain method. The estimations were made from specimens collected at fifteen-minute intervals.

hours as compared to two and three-quarter hours in chronic appendix cases. Food was present in all of the specimens of secretion in only 1 case, in the others it was absent in the last fifteen minutes to three-quarter hour, while in the chronic appendix cases, though secretion was obtained three-quarters of an hour longer, food was present in 3 cases in all of the specimens. A two-year gastrojejunostomy is interesting from the high actual acidity with a secondary rise at the end, and the length of time secretion was obtained, three and a half hours. This rather increased length of time corresponds to other observations.

The gastric symptoms in chronic appendicitis may be caused primarily by a reflex spasm of the pylorus with secondary changes in secretion and acidity (Aaron,[13] or, according to Fenwick[14] and McGuire,[15] the gastric secretions may be changed primarily, with the other changes secondary to the irritation of a hyperacidity. Fenwick believes the constant excess of free HCl gives rise to a spasmodic closure of the pylorus and also excites a violent gastritis with often interstitial hemorrhages. He believes that 12 per cent. of the cases of hypersecretion are due to disease of the appendix and that there is usually an increase both in quantity and acidity, when active irritation of the appendix is present. Paterson[16] says that the appendix influences the gastric secretion but thinks it due to intestinal stasis rather than pyloric spasm. Ochsner[17] says that there is undoubtedly a contraction of the ileocecal valve during an acute exacerbation of appendicitis. This in turn may give rise to a contraction of the duodenal and pyloric sphincter and in this way the normal passage of food from the stomach is impaired. Long and short, or local, reflex nerve paths to the stomach from the appendix and intestine have been demonstrated clinically and experimentally.[18]

[13] Chronic Appendicitis, Pylorospasm and Duodenal Ulcer, a Preliminary Note, Jour. Am. Med. Assn., 1915, lxiv, 1845.

[14] The Clinical Significance of Gastric Hypersecretion and its Connection with Latent Disease of the Appendix, Proc. Royal Soc. of Med., 1910, iii, 3, 177.

[15] Tr. South. Surg. and Gynec. Assn., 1911, xxiii.

[16] Appendicular Gastralgia, or the Appendix as a Cause of Gastric Symptoms, Proc. of Royal Soc. Med., 1910, iii, 3, 187.

[17] Further Observations on the Anatomy of the Duodenum, Am. Jour. Med. Sc., 1906, cxxxii, 1.

[18] Opitz: Quoted by Kenefick, Med. Rec., 1915, lxxxviii, 355.

Cannon, W. B.: The Mechanical Factors of Digestion, 1911.

Cannon, W. B.: The Acid Control of the Pylorus, Am. Jour. Physiol., 1907, xx, 301.

Carlson, A. J.: Reflexes from the Intestinal Mucosa of the Stomach, Am. Jour. Physiol., 1914–1915, xxxvi, 191.

Alvarez, W. C.: The Motor Functions of the Intestine from a New Point of View, Jour. Am. Med. Assn., 1915, lxv, 388–394.

Irritability in Different Parts of the Stomach, 1916, xli, 321.

Keith, A.: An Account of Six Specimens of the Great Bowel Removed by Operation with Some Observations on the Motor Mechanism of the Colon, Brit. Jour. Surg., 1914–1915, ii, 576–599.

A New Theory of the Causation of Enterostasis, Lancet, London, 1915, ii, 371–375.

Barclay, A. E.: Radiological Studies of the Large Intestine, Brit. Jour. Surg., 1914–1915, ii, 638–652.

In my experimental observations I used the Pawlow pouch in order to obtain pure juice and found it of value in controlling operative and postoperative hemorrhage to run a buttonhole suture around the incised stomach wall before invagination. In order to lessen the tendency to breaking down of the mucosa between the main stomach and the pouch I invaginated the cut mucosa and submucosa as Keeton[19] has suggested, not so that the closed edges of the two stomachs fell against each other, but so that they formed a cross

$$E.....A + \begin{matrix} C \\ B \\ D \end{matrix}$$ (Fig. 4).

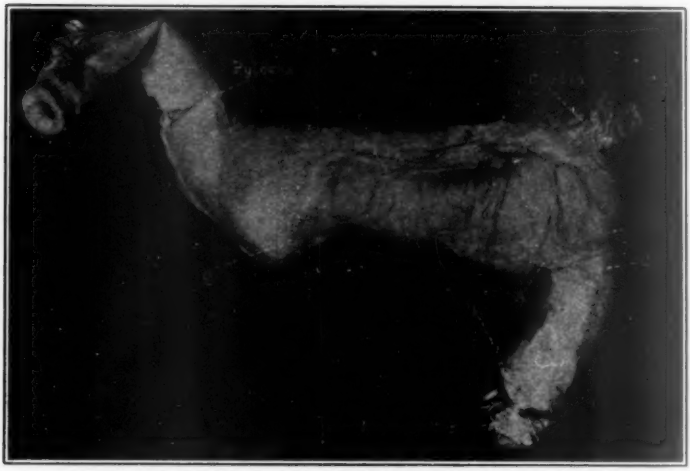

FIG. 4.—Photograph of Pawlow stomach in Exp. 5. Line *E-A* is the line of the incision through the stomach wall. From *A* to *B* the mucosa and submucosa have been cut and peeled back from the muscle after which the ends are invaginated along the line *A-B* and in the small stomach at right angles, *C* to *D*. The point *D* is located on the posterior wall opposite *C*. The pouch is completed by invaginating the stomach wall from *A* to *F*, leaving the small opening at *F*. The incision through the main stomach is completely closed from *A* to *E*.

In my experiments on dogs, lesions similar to chronic appendicitis with adhesions in the human were attempted. The cecum of the dog forms a rather long spirally twisted appendix. A stenosis of this cecum and adhesions to the colon, ileum and abdominal wall were produced.

ANIMAL EXPERIMENTS.

1. Pawlow pouch, January 17, 1917. Lesions of cecum, January 24, 1917. Slightly inflamed cecum removed and adhesions freed, January 29, 1917. Posterior gastrojejunostomy, March 5, 1917.

[19] Am. Jour. Physiology, 1914, xxxiii, 25

Chloroformed, May 28, 1917. Gastro-enterostomy and Pawlow pouch results good.

2. Pawlow pouch, February 23, 1916. Collections. Lesions of cecum, April 10, 1916. Posterior gastrojejunostomy, May 8, 1916. Collections. Dog chloroformed, August 4, 1916. Necropsy: adhesions of cecum to colon, ileum and abdominal wall. Gastrojejunostomy opening patent.

3. Pawlow pouch, March 2, 1916. Lesions of cecum, March 27. 1916. Chloroformed, April 2, 1917. Wound infection. Definite inflammation of cecum.

4. Pawlow pouch, October 20, 1916. After collections, lesions of cecum, November 20, 1916. Collections. Reoperated. Chloroformed, November 25, 1916. Necropsy: acute inflammation of cecum and peritonitis.

5. Pawlow pouch, November 27, 1916. Collections. Lesion of cecum, December 13, 1916. Inflamed cecum removed, December 28, 1916, adhesions to ileum, colon and abdominal wall freed. Chloroformed, January 13, 1917.

6. Pawlow pouch, December 1, 1916. Collections made similarly to experiment 5 as a normal control.

7. Pawlow pouch, January 2, 1917. Lesions of cecum, January 12, 1917. Distemper. Chloroformed, January 20, 1917. Necropsy: adhesions and stenosis of cecum.

8. Pawlow pouch, January 5, 1917. Lesions of cecum, January 15, 1917. Cecum removed and adhesions freed, January 20, 1917. Chloroformed, February 28, 1917. Necropsy: small communication between the two stomachs. Ulcer at suture line.

9. Pawlow pouch, January 16, 1917. Lesions of cecum, January 24, 1917. Acutely inflamed cecum removed. Peritonitis. Chloroformed, January 30, 1917.

10. Pawlow pouch, January 19, 1917. Lesions of cecum, January 26, 1917. Collections. Cecum removed, January 29, 1917. Distemper. Chloroformed, February 13, 1917.

11. Pawlow pouch, November 24, 1916. Collections. Emaciation and vomiting. Chloroformed, December 13, 1916. Necropsy: marked hour-glass contraction of stomach. No other pathology.

The following contains animal experiments illustrative of my results, the first column under "pH," showing the acidity determined by the gas-chain method. Under "HCl" is placed the dimethyl amino azobenzene and under "Total" the phenolphthalein, acidity, determined by the titration method.

EXPERIMENT 1. One of four test meals from Pawlow stomach before lesions were produced. Test meal, 75 grams Hamburg and 2 grams peptone:

Hr.	pH.	HCl.	Total.	C.c.
1	1.19	94	106	6½
2	1.27	72	94	1½
3	3.43	0	54	1
4	....	...	...	½

After production of stenosis of cecum and adhesions. One of five test meals:

Hr.	pH.	HCl.	Total.	C.c.
1	1.18	100	110	2½
2	1.18	90	104	1½
3	1.30	62	82	1
4	....	...	...	½

After removing cecum and freeing adhesions. One of seven test meals, one to twenty-three days after operation:

Hr.	pH.	HCl.	Total.	C.c.
1	1.22	98	119	3
2	1.23	96	110	2½
3	....	66	82	2
4	....	...	...	1

One typical test meal from five tests, four to seventeen days after a gastrojejunostomy:

Hr.	pH.	HCl.	Total.	C.c.
1	1.08	84	98	5
2	1.06	102	114	6
3.4	1.01	106	118	8
5	1.03	98	110	4
6	1.01	100	112	2

EXPERIMENT 5. Four test meals made from Pawlow stomach. Illustrative meal after 75 grams Hamburg and 2 grams peptone:

Hr.	pH.	HCl.	Total.	C.c.
Continuous secretion	1.43	42	48	1
1	1.28	60	66	4
2	1.32	60	66	5
3	1.33	68	74	3½
4	1.60	80	86	3
5	1.52	54	60	3
6	1.50	64	68	2½
7	1.26	64	68	2
8	1.43	42	60	1½

After production of stenosis of cecum and adhesions. One of two test meals:

Hr.	pH.	HCl.	Total.	C.c.
Continuous secretion	1.35	78	86	4
1	1.20	74	84	20
2	1.20	64	72	14
3	1.15	90	100	10
4	1.14	84	88	8
5	1.33	82	88	8
6	1.36	80	82	7
7	1.25	80	88	10
8	1.26	76	82	9
9	1.52	80	86	6

Twelve days after removal of inflamed cecum. No appetite. Test meal given by tube:

Hr.	pH.	HCl.	Total.	C.c.
Continuous secretion	1.10	104	116	3
1	1.30	94	104	2½
2	1.30	98	106	3

EXPERIMENT 8. Average of five test meals from Pawlow stomach. Test meal, 75 grams Hamburg and 2 grams peptone:

Hr.	pH.	HCl.	Total.	C.c.
1	1.25	85	105	4½
2	1.18	92	109	6½
3	1.22	70	80	2
4	1.49	80	95	1½
5	1.65	50	78	2
6	1.18	95	103	1
7	1.20	92	100	1

After production of stenosis and adhesions of cecum. Average of four test meals:

Hr.	pH.	HCl.	Total.	C.c.
1	1.23	74	85	7
2	1.16	86	96	5
3	1.16	62	87	4½
4	1.18	74	89	1½
5	....	28	54	½
6	....	24	48	½

After removal of long cecum. Average of five test meals:

Hr.	pH.	HCl.	Total.	C.c.
1	1.17	116	128	8
2	1.15	121	133	10½
3	1.16	113	125	5½
4	1.16	90	106	3
5	1.20	108	118	1
6	1.20	108	118	1

EXPERIMENT 10. Average of three test meals from Pawlow stomach. Test meal, 75 grams Hamburg and 2 grams peptone:

Hr.	pH.	HCl.	Total.	C.c.
1	1.26	89	104	3
2	1.22	74	94	1½
3	....	...	...	½
4	1.4	72	96	½

After production of stenosis of cecum and adhesions. Average of three test meals:

Hr.	pH.	HCl.	Total.	C.c.
1	1.14	102	116	4
2	1.13	107	122	1½
3	1.27	100	110	1
4	1.18	100	109	1
5	1.18	100	108	1

After removal of cecum and freeing of adhesions. Average of five test meals:

Hr.	pH.	HCl.	Total.	C.c.
1	1.12	118	130	3
2	1.14	116	124	4
3	1.12	116	119	1½
4	1.14	110	114	1
5	1.14	110	112	½

Results of Experiments. In considering the results of the animal experiments, there was a definite increase in secretion in nearly one-half of the cases after lesions of the cecum were produced. In 1 case there was also an increase in continuous secretion; in the others there was a hypersecretion with a slightly longer period of flow. After removal of the "cecum" there was also a marked increase in quantity in 1 case and slight increase in another. The actual acidity after the lesions, as well as after the removal of the "cecum," was slightly higher than that ordinarily found corresponding to an increased flow of secretion. After gastrojejunostomy (Experiments 1 and 2) there was a decided increase in the rate of secretion in both cases as well as a prolonged flow of juice in 1 case. The acidity was slightly increased after gastrojejunostomy, associated with a more rapid rate of flow. After hour-glass contraction of the stomach in 3 cases there was no decrease of acidity, although frequently a decrease in such cases has been found clinically. There was a slightly increased rate of flow in some instances, in others a decreased rate, associated with emaciation and vomiting. One case, Experiment 11, is listed.

Summary of Clinical and Experimental Work. In a group of surgical cases, it has been shown that the curve of acidity may rise higher at the end of digestion than it has during the digestive rise. After certain surgical lesions have been made upon the gastrointestinal tract of animals, it is demonstrated that there is a slight increase in acidity in the secreted gastric juice; in some reflex manner, however, lesions of the cecum or other changes may cause an increased rate of flow. There must be some disturbance of the factors concerned in neutralization of the acidity associated with the factors controlling the discharge of chyme through the pylorus. The contour of the curve of acidity must be influenced by the food and fluids present, the intensity and duration of the appetite and food secretion, the emptying time of the stomach, the regurgitation of alkaline and duodenal contents, the gastric mucus and the saliva.

Conclusions. 1. The clinical study of the gastric secretion must be done by examination of specimens taken at short intervals during digestion. Examination of a single specimen for comparative purposes is inexact and inadequate.

2. There is often a persisting high acid secretion after the digestive period. The digestive acidity may fall with a secondary late rise. Frequently surgical cases have this type of curve.

3. Clinically, the pH derived from the titration method is uniformly higher than the actual acidity as determined by the gas-chain method.

4. In animal experiments, after production of chronic inflammation of the long appendix of the cecum, with adhesions, after the removal of this appendix, after gastrojejunostomy and hour-glass stomach, no definite increase in actual acidity of pure gastric

juice was observed. There was an increased rate of flow and a prolonged flow in some cases.

5. The presence of increased acidity in the stomach contents in these surgical conditions must therefore be explained by factors noted in the summary above and not to an actual increased acidity of the gastric juice.

NOTES ON THE PROGNOSTIC VALUE OF PSYCHOMETRIC TESTS AS COMPARED WITH CLINICAL SIGNS IN EPILEPSY.[1]

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From data now at hand it is obvious that the diagnosis and prognosis of many cases of essential epilepsy rest in no small degree upon accurate analysis of the so-called mental stigma of the disorder, the epileptic constitution, as well as the modifiability of the latter under appropriate training treatment. Likewise the course of the disorder is to be judged by the presence or absence of deterioration and its degree.[2] As regards deterioration, in the past we have been content for the most part to indicate it purely on the basis of a clinical estimate of behavior, ability to do work and like data. However, it now seems opportune for us to call to our aid a more precise method to determine the initiation of deterioration not only for prognostic reasons but also that one may early determine the efficacy of any definite plan of training treatment. The psychometric work of Eberschweiler and Jung and, more especially, the proofing test of Hahn, are suggestions in point. Although a large number of studies of this psychological character has appeared, Hahn[3] was able, in 1913, to check up some of his work on the same clinical material studied in 1903 and 1908. The time interval between the two sets of studies were from two to four years. As is natural the findings in his studies had to exclude the mental infirmity due simply to an arrest in growth and development as well as a proper allowance made for the wide variations of the primary endowment in such individuals. Hahn employed a

[1] Delivered as a part of the Symposium on Epilepsy and Allied States, Randall's Island, June 4, 1917.

[2] Clark: Clinical Studies in Epilepsy, Psychiatric Bull., January, 1916, to January, 1917.

[3] Association Studies in Youthful Epileptics, Archiv f. Psychiatrie, 1913 lii, 1078.

very free and modifiable system of testing. In brief, he found the following in 7 cases studied:

The first case of medium deterioration showed an increase in tendency to revert to the child type of reaction (increase of deterioration). In the second case of mild deterioration he found the reaction time became prolonged in the later tests and there was a tendency to greater perseveration; clinically the case was supposed not to have increased in deterioration. In the third case the clinical and the psychological deterioration were quite in accord in spite of a cessation of attacks; there had never been many attacks in the case, and none since trephining a year before the final testing. Hahn's comment coincides with that of many other observers, clearly set forth by MacCurdy[4] in his epileptic deterioration study. Hahn says: "The psychic alteration in epileptics cannot therefore be straightway due to the convulsions, either to their number or severity, and an avoidance of attacks, however valuable practically, in most cases does not indicate a 'therapia magna.'" The fourth case studied was a child, aged thirteen years, at time of report, who showed deterioration in association with normal development. In the tests at two-year intervals the latest showed a prolongation of reaction time and a marked tendency to perseveration (signs of deterioration). It was interesting to note that the mental regression in nowise seemed to retard any phase of the physical growth. The fifth case was one of slight deterioration in a woman, aged thirty-three years. The tests showed practically no increased deterioration in spite of the fact that the woman had had severe attacks rather frequently since early childhood. It seemed possible, from the favorable testing (in 1904), that this woman might finally recover. The latest report (1908) showed that this outcome might still be expected. The sixth case, a woman, who had had no attacks from the first to the last test in a period of two years, showed steady and apparently normal development. The reaction time gradually approximated the normal and perseveration disappeared. In 1906 the psychological test was in accord with the clinical opinion that the case was a good example of "arrest," which was in sharp contrast to Case III, who also ceased having attacks but continued to deteriorate. Case VII, a woman, aged thirty-seven years, showed psychological accord with the clinical record of progressive improvement; the former even outran the prognostic acumen of the clinical recognition of the betterment.

There can be no doubt that a pyschometric setting of epileptics would be eminently helpful to the diagnosis, prognosis and therapy of the disorder. Although the work may be fraught with much difficulty the study ought not to be neglected. At present the clinical criteria are too elusive and unsatisfactory to estimate the epileptic deterioration.

[4] A Clinical Study of Epileptic Deterioration, Psychiatric Bulletin, April, 1916.

As an earnest of the foregoing we have undertaken some repeated testings in a few epileptics at the Randall's Island institutions. The cases were selected at random for the purpose of noting the accordance or non-accordance of the changes in (1) convulsive frequency, (2) the clinical evidences of alterations in conduct, behavior and work, and (3) the more precise analysis of a psychological testing by the Binet, performance and simple word-association tests for recording the reaction time, perseveration and the range and flexibility in the intellectual and emotional life of the epileptic.

Case I.—The first case is that of Harold E., who was admitted to the Randall's Island institutions April 21, 1916. He is now fourteen years old. He had an apparently normal development of childhood. The onset of his grand mal epilepsy at nine years of age seemed to have had little influence on his school work until the year preceding his admission, when he had to repeat one year. The attacks were reported to have occurred three or four weeks apart at that time. He has always possessed the character defects of the epileptic make-up, and these have become more pronounced during the past year.

Two years ago he Bineted 10.4, which was 1.6 years below his real age. During the examination it is recorded that he had a quiet demeanor; he was interested in everything in the room and talked in a straightforward manner, but his attention was very easily distracted. His reproductive memory was very good (six digits in figures and fifteen syllables). His general intelligence seemed normal. He had a normal grasp on the central idea of a story and laughed heartily over a humorous picture; he easily identified street scenes. He was rather unstable emotionally, and was reported to be quarrelsome at times. In 1915, when the first test was made, the attacks averaged one in three or four weeks, and were always grand mal in type, occurring at night. They continued through 1916 at about the same frequency. At present (1917) the frequency and severity of his epilepsy has apparently not undergone much change. However, his mental examination by the Binet test now shows him to be 8.2, two years less in the two-year interval since his first test. The whole test at present indicates considerable epileptic deterioration, there is a superficial reaction to word-association, and his time reaction is very much slowed; for instance, such words as book, storm and letter he takes thirty-five to forty seconds to respond. There is a marked tendency to perseveration, a clinging to the one type of word-response for a number of unrelated words given. His attitude during the test was marked by mannerisms. For instance, he sat with a dull, lethargic expression, his eyes shaded with his hand, and in an annoyed manner frequently held up his hand to the examiner and said, "Keep quiet," and "Do not say anything." Evidently he is aware of the slowness

and confusion of his thoughts and his difficulty in grasping the simple tests given him. His attitude, on the whole, was quite friendly throughout the examination, but he evidenced an abnormal reaction in shallowness of mental grasp and a rigidity in physical and mental response.

In this boy we find no apparent change in the number and severity of the epileptic attacks, but other clinical and psychological evidences show a relatively rapid progress in mental deterioration.

CASE II.—The next case is that of Elliot M., a man, now thirty-five years old. His birth was prolonged and instrumental. He did not talk until two years of age, and only formed full sentences when three years old. He began school at seven and discontinued at fourteen. He never reached the grammar grades, and often played truant. He often stole money as a boy, and drank, was passionate and of the typical epileptic. At twenty he had a right hemiplegia. A month after this stroke he had his first seizure. The attacks are mostly of the grand mal type. Two years ago, at the age of thirty-three, he Bineted 8.6 years. His performance test was fair but the reactions were slow and deliberate. His perception of form was good. His interest and attention were good. Perseveration was marked. While his coöperation on the test was good he required much encouragement. He was much embarrassed at not doing better at tests, not usually seen in ordinary essential epileptics. He had much difficulty in expressing himself, as he said, "The answers come to me and then leave me and I can't recall them."

He had three or four grand mal attacks a week the first three years. During the past five years the attacks have diminished in severity and frequency, and there now is a slight warning of a "rush of blood to the head." He is now able to lie down on the floor and unbutton his shirt before he becomes unconscious. His attacks now have diminished to about two a month instead of that many a week several years ago. His present mental examination, however, shows he Binets to 7.6 years of age mentally. He has lost a year in rating in the two years in spite of the diminution of epileptic attacks. It was found that while his attention was good throughout the test he thought more slowly and laboriously. His memory is badly impaired. He says he once read easily but cannot now recognize simple words. His reaction time is very slow; to such words as love, ship and door his time is over forty seconds. As this patient has a positive Wassermann in the spinal fluid his right hemiplegia is probably a specific thrombosis and his attacks are symptomatic or epileptiform.

The case is interesting because in spite of a great diminution of grand mal attacks the patient is deteriorating mentally, as shown by precise tests, although ordinary clinical evidence does not show this; that is, he is better behaved, does more consistent and good work

about the institution, and yet the underlying organic injury to the brain is probably progressive in character.

CASE III.—The next case, Mary D., is that of a woman, aged forty-six years, whose seizures began at puberty and continued for a few years, and occurred every other day. In spite of her epilepsy she was married at twenty-five and has one normal daughter, now seventeen years of age. Two years ago she Bineted 8.8 years. During the mental examination two years ago her demeanor was quiet. She had the general appearance of discouragement. Her memory for former and recent events was poor. Of ten pictures displayed in succession she was unable to recall any. She had poor mental grasp on stories and detailed descriptions. Her power of reasoning was poor and she was easily confused. She was having about fifteen seizures a month at the time of this examination. Her attacks apparently have not changed in frequency or severity since the testing two years ago.

Her present test shows her to be 7.6 years mentally, a loss of one year in two years. Her reaction time varies from two seconds to one minute and fifty seconds. In general the test showed great distractability; she tried to talk of things that had no bearing on the tests. Her judgment and comprehension were poor and there was a great slowing in the reaction time.

On the whole the case showed deterioration of a mentality that also gave evidence of a defective primary endowment. In spite of the fact that there was no apparent change in the seizures in frequency or severity this patient is steadily deteriorating, and here the clinical and psychological tests are in accord if one excludes the consideration of the epileptic attacks which have undergone no change.

CASE IV.—The next case, Carrie H., is that of a young Polish woman, aged twenty-one years, whose epilepsy began soon after puberty and whose mentality was that of feeble-mindedness. Two years ago the mental examination was difficult to make on account of the patient's inability to handle the English language. She spoke Polish. Her answers were prompt, however. She Bineted to the mental age of 6.6 years. The patient stated persistently that she had her first epileptic attacks at seventeen, and that at first they occurred irregularly twice a week. In 1916 she had 84 attacks, which was considerably less than the year before. For the present year the attacks show even fewer than 1916. The present test, however, shows that she is of the mental age of 5.8 years, a loss of a year in mental grading. Her demeanor was quiet and friendly. There was quite marked slowness in word-association, such as for girl, rain and island; the responses were all over thirty seconds. Her memory was fair; she still had a nervous manner in talking. She still has a poor knowledge of English. The clinical facts, including the diminution of epileptic attacks, are rather at

variance with the psychological testing. The latter showed that there was an increasing deterioration upon a primary inferior mental endowment. The deterioration was shown in an increased emotional poverty of ideas, perseveration and an increased slowing of the process of thought.

CASE V.—The final case, Rosa C., is that of a young married woman, aged twenty-nine years, whose epilepsy began at sixteen years of age. She had been married and was pregnant eight months at the time. It was a poor marriage and against the parents' advice. The husband drank to excess and the patient greatly feared bearing children, and was much worried before the first attack. Two years ago she Bineted 9.8 years. On the form board she gave only fair results. The picture-completion test was disproportionately good. Coöperation, interest and attention were good. She was quick to react. Her manner was open and friendly and cheery. Her attacks, which occurred about three a week two years ago, are now a little less frequent, being but one or two a week. Her present mental testing shows she is 9.6, which is only a little less than that shown two years ago. Her reaction time was much better than the others tested in this series; her longest reactions in simple words were eighteen and twenty-two seconds. Her demeanor was quiet and friendly and her attention was good throughout. She says simple, silly things, gives the nurses no trouble and helps at the scrubbing, but her work is not dependable. She is rarely excited.

Here we have a less conclusive case for the relative value of clinical and psychological testings. There is an improvement in regard to seizures and a somewhat better adaptation to her life and work, although the latter is rather poorer than formerly. Psychologically the testing showed a slight retrogression, hardly conclusive enough, however, to possess a deteriorating significance.

In conclusion we may say that the data here presented, while too few for any general statement, are of sufficient clinical importance to show that we must not depend upon a diminution of the epileptic attacks solely in an epileptic to warrant giving a better prognosis, but that the clinical facts of improvement in character and conduct, and kind of work, are to be included. We must also incorporate a more precise mental testing by simple psychological means. Unless all three groups of facts are relatively in accord one ought not to make a positive prognosis of improvement or deterioration in any given case. In time we hope to simplify the psychological testing so that it may be easily performed in ordinary office practice. It is, however, already evident that the single word-association test will enable the physician to judge of the degree of perseveration and the length of reaction time, which are the main criteria for determining the presence and amount of mental deterioration.

GUMMOUS SYPHILIS OF THE THYROID GLAND.

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Lancereaux[1] in his text *Traite historique et pratique de la syphilis*, published in 1868, wrote "We do not know of any case which gives evidence of a gummous deposit in the substance of the thyroid gland." Although that statement could not be made truthfully at the present time, the number of reported cases of late syphilis of the thyroid gland are surprisingly few, and in the light of our present knowledge we must regard it as an unusual manifestation of the disease.

The following case was seen at the University Hospital during March, 1916:

Mr. W. P., entered the University Hospital because of the presence of a swelling in the neck and of discharging sinuses over the upper part of the chest. The family history was negative. The patient is married, his wife living and well, and he has three healthy children. One child, the first born, died two days following birth, prolonged labor being the cause assigned. The patient's past history was uneventful. He denied gonorrheal infection, and no history of a chancre could be obtained. He denied premarital or extramarital exposure. Seven years ago he suffered from loss of appetite and "general weakness," and about this time he had a number of reddish sores, covered with whitish membranes, in the mouth. These sores persisted for eight months, new ones appearing as the older ones disappeared. There were no other symptoms suggestive of secondary syphilis at this time, although he states that his eyes tired easily, and while they were not inflamed or painful the vision in the left eye became less acute and has remained so ever since.

The appearance of the thyroid tumor was preceded by various lesions. About three years ago he noticed a swelling the size of the palm of the hand over the upper part of the sternum. This was painless and did not involve the overlying skin, which was of normal color. Fifteen months ago he was struck forcibly at the site of the swelling. A week later the skin over the tumor had become reddened and the color gradually deepened until at the end of the second week it was a purplish blue. Four days later the skin began to ulcerate and he visited a physician. The latter curetted away a large mass of necrotic tissue, and although this procedure was carried out without an anesthetic it was entirely painless. The

[1] Traite hist. et pratique de la syphilis, 1868, i, 377.

ulcer refused to heal, however, but increased in size. Two months later his doctor made a vertical incision, about three inches long, through the center of the ulcer, resected the surrounding skin and curetted the sternum and the proximal portion of each clavicle. The ulcer then began to heal and in about three months was replaced by a firm scar. Nine months ago a new swelling appeared in the upper portion of the scar. This was also painless and the overlying skin was uninvolved. Two months later this growth was incised and healing followed, although it was two months before recovery was complete. Meanwhile the patient had been subjected to another trauma, this time at the costochondral junction at the lower third of the sternum. Almost at once a slightly tender swelling appeared. This reached the size of a walnut and persisted until the patient entered the hospital. About the time that the tumor, which appeared in the scar, was excised a small swelling appeared near the left sternoclavicular junction. Three months later the skin over this tumor began to ulcerate and an opening was formed through which a profuse purulent discharge came, and the latter continued until he entered the hospital. A month before this ulcer appeared, still another small swelling appeared over the sternum, just above the right sternoclavicular articulation. This broke down about two months later, resulting in the formation of a sinus with a purulent discharge. This discharge likewise continued until the patient entered the hospital. The patient was unable to remember the exact time of the appearance of the thyroid swelling, but he stated that it began about one year ago. The thyroid tumor was very hard from its beginning, and continued to increase in size rather rapidly up to the time we first saw him. The cervical glands on the left side had been slightly enlarged for some time before the thyroid tumor appeared, but increased in size rapidly along with the latter, and the skin over them became reddened and somewhat fixed to the underlying tissues.

Examination. The patient was a tall, fairly well-nourished man. Scalp and skin of the face were clean. The pupils were equal, but reacted sluggishly to light. At the upper end of the sternum was a spoon-shaped ulceration, located at the center of a patch of dense scar tissue nearly as large as the hand. Just above this two small, sharply punched-out ulcers were seen, one above each sternoclavicular articulation. There was a considerable purulent discharge from these ulcers. A probe passed into the ulcer at the left could be introduced easily for a distance upward of about two inches, and it was then found that its end lay deep in the substance of the enlarged left lobe of the thyroid, which could be moved easily with the probe.

The thyroid tumor was confined to the left lobe of the gland and a small portion of the adjacent isthmus. The swelling was about the size of a hen's egg, presented a rather uneven, nodular surface, and was very firm, having a decidedly rubbery consistency. The tumor and ulcers were entirely painless.

The anterior cervical glands, especially along the lower portion of the chain, showed a shotty enlargement, and the skin over them was reddened and somewhat fixed to the underlying tissues.

At the costochondral junction of the sixth rib there was a hickory-nut-sized, painless, hard tumor, fixed to the overlying tissues and skin. Both testes were hard and showed some nodulation at the upper poles. There was also a marked hydrocele.

The mucous membranes were clean. The glands, aside from those already described, were not enlarged. The biceps, triceps and knee-reflexes were normal, but the left Achilles reflex was lost and there was analgesia of the left Achilles' tendon. The spleen was easily palpable, a firm edge being felt about one finger-breadth below the costal margin.

Examination of the lungs showed slight impairment at the front and back of the right apex, but no signs of any active pulmonary disease. Roentgenological examination of the lungs showed absolutely no signs of tuberculosis.

In spite of the fact that the patient had experienced no difficulty in breathing or swallowing, he was referred to the department of otolaryngology for examination, and the larynx was found to be entirely normal, the vocal cords approximating perfectly. Fluoroscopic examination following deglutition of barium lactate showed the esophagus to be of normal contour, while a roentgenogram showed the trachea to be of uniform diameter and with normal narrowing at the glottis.

Although the patient vehemently denied that he had ever contracted syphilis, a diagnosis of thyroid syphilis was made. The other conditions considered were tuberculosis and malignancy.

Two days later the Wassermann was reported to be four plus, thus substantiating the clinical diagnosis, and the patient was advised to return to the hospital for antisyphilitic treatment. He again entered the hospital, and at that time was given an injection of 0.3 gm. arsenobenzol (Schamberg), and received potassium iodide in large doses. On the fourth day after the first injection the ulcerative lesions had already begun to heal. The injections of arsenobenzol were continued thereafter weekly in dosages of 0.6 gm. for six weeks. Eight days after the first injection the spoon-shaped ulcer over the sternum had practically healed, the gummatous node at the sixth rib had grown much smaller, and the two suprasternal ulcers were much smaller, although the probe could still be passed easily through the larger one and into the thyroid. The thyroid swelling was also considerably smaller. Within four weeks the suprasternal ulcers were practically healed and the probe could be passed only with difficulty. Two weeks later, when the patient reported for his sixth injection, the ulcerative lesions were completely healed and the thyroid swelling was not larger than a small walnut. The tumor was still very hard. The testicular swellings and the hydrocele were likewise somewhat reduced in size.

It is unfortunate that microscopic sections were not made, but it was not deemed advisable to interfere with the thyroid gland surgically, and no specimen was secured. The diagnosis would seem to be established beyond question, however, without the aid of the microscope. The presence of typical, painless, sharply punched-out ulcers over the sternum, with nodular gummatous lesions elsewhere, the positive Wassermann reaction and the ready response to antisyphilitic treatment of the thyroid tumor together with the other lesions would seem to justify the diagnosis.

Davis in an article published in 1910 enumerates 20 cases of tertiary syphilis of the thyroid in the literature, including his own. It does not seem, however, that all of these cases can be accepted as cases of tertiary thyroid syphilis. For example, the only data obtained concerning Abraham's cases were found in Richardson's[2] text, where the reference not being given the latter says: "Abraham reports 3 cases of women who developed exophthalmic goiter, the first five months after the primary lesion, the second during the height of the secondary infection and the third two years after infection, all of whom were cured by antisyphilitic treatment." These cases are therefore apparently reported as examples of exophthalmic goiter, developing during the course of syphilis and not as thyroid tumors of the gummatous type. Furthermore, in point of time, the first 2 cases may much better be considered as changes occurring in the thyroid during secondary syphilis, a not uncommon finding. The last case, in which exophthalmic goiter appeared two years following infection, must be regarded as a case of exophthalmic goiter of syphilitic origin and not as a gummatous lesion developing in the gland. Such a case was recently reported by Clarke,[3] the exophthalmic goiter in his case being unquestionably of syphilitic origin. All of the remaining cases may apparently be accepted as examples of the condition under consideration, and inasmuch as considerable variation in the thyroid lesions exists in different cases, it seems advisable to review them briefly in their chronological order.

The earliest mention of gummatous lesions of the thyroid is found in an article by Demme.[4] His 3 cases occurred in infants, the victims of hereditary syphilis. He states that syphilis of the thyroid is found in lues hereditaria in the form of gummatous nodes. He saw 2 cases of this type, which, in addition, showed at autopsy definite syphilitic lesions of the liver. A third case showed gummatous nodes in the spleen as well. In all of these cases pustular syphilids of the skin were present. The gummatous tumors of the thyroid were of varying size, grayish or grayish yellow in color and sharply demarcated, like malignant or tuberculous nodules; in one of the cases a single node showed a soft jelly-like consistency.

[2] Diseases of the Thyroid and Parathyroid Glands, 1905, p. 140.
[3] Jour. Am. Med. Assn., 1914, lxiii, 1951.
[4] Krankheiten der Schildrusen, Bern, 1878, iii.

In 1883 Wolfer[5] wrote that syphilis of the thyroid existed, but that there had been no accurate investigation of the subject. He stated that Navratil reported a case with a gumma the size of the fist, but that histological confirmation was lacking. Unfortunately, I was unable to secure Navratil's original article.

Barth and Gombault[6] reported the first case of tertiary thyroid syphilis in an adult in whom histological confirmation was presented. The patient was a woman, age not given. The lesion was a swelling of the thyroid, but was not described carefully. No respiratory symptoms were occasioned, nor was any pathology of the respiratory system present. No mention of treatment is made.

In 1887 Fraenkel[7] reported an interesting case: The patient, a woman, aged forty-two years, succumbed and came to autopsy. She had had a cough for two years, which was thought to be due to pulmonary tuberculosis but investigation showed it to be due to syphilitic ulceration of the trachea, this being the dominating features of the case. The thyroid involvement concerned the isthmus mainly, a small portion of the right lobe being affected as well. The tumor was a small one, having a consistency different from that of the rest of the gland, grayish yellow in color and not well demarcated from the surrounding tissue. The tumor was firmly adherent to the larynx. Among many other findings indicative of syphilis at autopsy were nodular gummata of the liver and right kidney.

In 1892 Kohler[8] recorded the case of a woman, aged forty-three years, who had had a swelling of the neck during youth, but was otherwise well. In November, 1891, she was troubled with chills, nocturnal headaches, dizziness and fainting. At the same time she noticed swelling of the skin of the face, hands and neck. The case was obviously one of myxedema. In February, 1891, the symptoms were less marked and the diagnosis was not so apparent. At this time it was noticed that there was a swelling at the anterior part of the neck differing from that caused by the edema. It was hard, subcutaneous and showed several nodular prominences. The patient was operated some time later and the tumor, which was found to be located in the thyroid gland, looked like a broken-down gumma when removed, but the cut surface showed a solid tumor of grayish to grayish-yellow color. Antisyphilitic treatment gave splendid results, the swelling disappearing entirely, while an ulcer which had been present over the sternocleidomastoid muscle healed rapidly. The remaining thyroid gland was of normal consistency and thyroid function was restored.

Two years later Pospelow[9] reported the case of a man, aged

[5] Arch. f. klin. Chir., 1883, xxix, 827.
[6] Progrès méd., 1884, xii, 834.
[7] Deutsch. med. Wchnschr., 1887, xiii, 1035.
[8] Berlin. klin. Wchnschr., 1893, xxix, 743.
[9] Monatschr. f. prakt. Dermat., 1894, xix, 125.

forty-five years, who, after many recurrent syphilitic manifestations, developed diabetes insipidus and a tumor of the thyroid, in association with which there were also some symptoms of myxedema. Both the diabetes and thyroid condition responded readily to treatment with mercury and iodide.

The next report was that of Bruce Clarke[10] (1897). His patient, a woman, aged thirty-eight years, showed a hard, cylindrical tumor of the thyroid gland, reaching from the hyoid bone to the top of the sternum. There was a typical punched-out, gummatous ulcer of the skin near the upper margin of this tumor. The patient complained of difficulty in breathing and swallowing. Previous to the appearance of this tumor the patient had had numerous gummatous ulcers of other parts, all of which had disappeared rapidly under treatment with potassium iodide. The thyroid tumor did not respond well to this treatment and tracheotomy was necessary. After the operation the use of potassium iodide was resumed and the tumor rapidly disappeared, although considerable sloughing occurred.

Küttner[11] reports the case of a man, aged twenty-seven years, who had had a goiter since childhood. For several years before he was seen by Küttner he had noticed moderate dyspnea on exercising. Two weeks previous to his appearance at the clinic he had a severe attack of dyspnea. At this time his breathing was very stridulous even when he was at rest. The right lobe of the thyroid gland showed a fist-sized swelling. This was very hard, was not easily movable and seemed cemented in the tissues of the neck. The tumor was partly retrosternal and had pushed the trachea far to the left. Laryngeal examination disclosed a right-sided recurrent paralysis. The left lobe of the gland was also enlarged, but was soft and easily movable. The clinical diagnosis was carcinoma. Operation was attempted, but the tumor was so firmly adherent to the trachea and other structures of the neck that only a small portion was removed for microscopic examination. Since the histological findings suggested syphilis the patient was given large doses of potassium iodide. The tumor disappeared rapidly and the patient soon breathed freely. When seen six months after the operation he was in good health and had been working steadily.

Küttner also reported the case of a woman, aged thirty-nine years, who had had a small goiter since childhood. She contracted syphilis at the age of eighteen years. For the past four months she had noticed an enlargement of the thyroid and had also noticed that the gland was becoming harder. She soon began to complain of dyspnea. Upon examination a fist-sized swelling of the left lobe of the gland extending from the angle of the jaw to the sternum was found. The tumor was fairly movable, easily palpable, very hard and presented

[10] Lancet, London, 1897, ii, 389.
[11] Beitr. f. klin. Chir., 1898, xxii, 517.

a nodular surface. It was covered by normal skin. There was a left-sided, recurrent paralysis and a definite stridor developed when the patient exercised. A diagnosis of carcinoma was made and the left lobe of the gland removed. A number of enlarged cervical glands were also excised. Recovery was uneventful and the patient was discharged. The diagnosis of syphilis was then made, with the histological picture as its basis. She returned five months later with a syphilitic ulceration of the soft palate and the lateral palatine arch. The thyroid gland was still in good condition and she had no difficulty with her breathing. The ulcer of the palate disappeared quickly under treatment with potassium iodide. When seen five years later her health was very good.

Wermann[12] recorded, in 1900, the case of a man, aged twenty-four years, who gave a history of a very active syphilitic infection. For five years following his infection he had suffered many syphilitic accidents. The sixth year the patient's neck enlarged rapidly, due to a symmetrical swelling of the thyroid gland. The condition seemed to be a simple goiter, unaccompanied by symptoms. The gland was uniformly enlarged, soft and painless. The swelling did not subside under treatment with potassium iodide, but as soon as mercurials were employed the tumor rapidly decreased in size. Wermann thought that this was unquestionably a syphilitic manifestation, inasmuch as it appeared while the patient was taking potassium iodide, and although it remained uninfluenced by this drug, involuted rapidly under mercurial treatment.

Mendel's[13] 3 cases, all occurring in women, were reported in 1906. The first patient, aged thirty-eight years, had had a swelling in the neck at twelve years of age. Six months before she was seen by Mendel this swelling increased rapidly, reaching the size of a child's head. The tumor, which was hard and nodular, affected the right side of the gland. Dyspnea was so great that a tracheotomy was performed and the gland extirpated, but the patient died two days later as a result of heart failure. Autopsy showed syphilitic involvement of the spleen and liver as well.

The second patient, a woman, aged thirty-eight years, developed a hard, nodular tumor, the size of a hen's egg, in the left thyroid lobe. This tumor was of three months' duration, and following administration of potassium iodide disappeared completely.

The third patient, aged sixty-three years, had had a slight enlargement of the left thyroid lobe for some time, but suddenly a hard tumor developed in the same lobe. This caused dysphagia and dyspnea, and after five months a tracheotomy had to be performed, a diagnosis of inoperable carcinoma having been reached. The esophagus was also involved extensively. Three months later the tumor reached from one angle of the jaw to the other, and the patient

[12] Berlin. klin. Wchnschr., 1900, xxvii, 122.
[13] Med. Klin., 1906, ii, 833.

suffered attacks of dyspnea and heart weakness. Inasmuch as the slightly swollen glands of the neck did not have the consistency of cancerous glands, and as there was no ulceration or metastasis, antisyphilitic treatment was begun. The tumor disappeared rapidly, and in six weeks' time, the cannula having been removed, she was discharged as cured. But in six weeks she returned with a hard, painful tumor of the left lobe of the thyroid, which speedily involved all the tissues of the neck, and death ensued in six weeks. Mendel considered this case as one of malignant change following a syphilitic gumma.

D'Arcy Power[14] records the case of a man, aged fifty-three years, who had contracted syphilis thirty years ago and had had various tertiary manifestations since. When seen by Power he had a tumor of the neck which had been present for one month. The growth was an oval-shaped lesion involving the right lobe of the thyroid gland. It was hard, had a smooth surface and rounded margin and was painless. The swelling was about two inches in length and one inch in width, extending obliquely upward and outward from the episternal notch to a point one inch above the clavicle. The growth was not adherent to the surrounding tissues and did not move on swallowing. The outer end was so hard that it was thought to be calcified. The skin overlying the lesion was normal. Complete recovery followed one month's treatment with potassium iodide and ammonium carbonate.

In 1912 Poncet and Leriche[15] saw a woman, aged thirty-eight years, who had had for the past six months a diffuse swelling of the thyroid gland, more marked on the right side. This tumor was so hard that it was almost wooden in consistency and had begun to infiltrate the other tissues of the neck. The growth had compressed the larynx, giving rise to dysphagia, dyspnea and hoarseness. Treatment with potassium iodide and mercury caused the tumor to disappear, but it soon returned, with the symptoms more marked than before. This time the tumor failed to respond to the same treatment, but involuted rapidly when salvarsan was employed.

Two cases of thyroid syphilis were reported by Sebileau.[16] A woman, aged twenty-eight years, came to him for treatment of a swelling of the neck. Examination showed a hard, painless swelling of the thyroid the size of an orange. This so interfered with respiration that a diagnosis of cancer was made and operation was attempted. The tumor could not be removed, however, as it was fused at the trachea, the rings of the latter being completely degenerated. Potassium iodide and mercury produced a speedy recovery.

The next case was a man, age not given, who showed a goiter-like tumor, firmly adherent to the surrounding tissues, and clinically of

[14] System of Syphilis, 1908, ii, 168.
[15] Bull. et mém. Soc. de chir. de Paris, 1912, xxxviii, 783.
[16] Ibid., 1911, xxvii, 1305.

an appearance typically malignant. Buds of this tumor projected into the lumen of the trachea. Recalling the last case, antisyphilitic treatment was instituted and complete recovery followed.

The most recent case reported is that of Lloyd Thompson.[17] A man, aged seventy-two years, giving a history of syphilitic infection, had suffered four years previously with tachycardia and palpitation of the heart, had lost weight and felt weak and had albumin in the urine. When seen by Thompson there was present a tumor of the neck in the region of the right lobe of the thyroid gland. The growth was about 10 cm. long, 4 cm. wide and seemed to be about 2 cm. in thickness. The tumor was movable and painless. There was slight protrusion of the eyes. The Wassermann reaction was four plus. Under treatment with mercury and potassium iodide the tumor rapidly disappeared, and in six weeks' time was barely palpable. The pulse and blood-pressure, both of which had been high, also returned to normal, and albuminuria, which had been fairly marked became so diminished, that only a trace of albumin was present.

In addition to these reported cases there is on exhibition in the Museum of the Royal College of Surgeons a specimen of gummatous syphilis of the thyroid gland. The trachea is somewhat stenosed as a result of the thyroid tumor.

The total number of authentic cases recorded then, including the present case and that of Navratil, is 23. The ages of the patients varied from infancy to seventy-two years, the majority of the cases occurring in middle-aged individuals. Three of the cases, those of Demme, occurred in heredosyphilitics, while a fourth case undoubtedly belongs in this category. Of the remaining 16 either history or previous luetic manifestations stamped the patient as syphilitic in ten instances. In the remaining cases the histological findings, either at operation or autopsy, or the effect of treatment, must be relied upon as evidence that the individual was suffering with syphilis.

In only 18 of the 22 cases was the sex of the patient reported, being omitted in Demme's 3 cases and in 1 adult case. Syphilitic involvement of the thyroid shows a marked preponderance in the female sex, 11 of the 18 occurring in this sex, a proportion of nearly 2 to 1. When we consider that syphilis is much more common in the male this difference is even more striking. The transient changes occurring in the thyroid in secondary syphilis are also seen much more frequently in women, and the question as to why syphilis, like goiter, should attack the thyroid gland so much more frequently in women than in men offers an interesting field for speculation.

Thompson states in his article that Montgomery has suggested that the comparative infrequency of tabes dorsalis and general paresis in women might be due to the greater activity of the thyroid

[17] Am. Jour. Syph., 1916, i.

in this sex on the theory that iodothyrin, the principal constituent of the thyroid secretion, exerted specific influence on the Treponema pallida, and so modified them as to prevent neural syphilis. This theory is hardly tenable in the light of the present statistics, showing a preponderance of syphilis of the thyroid in the female.

Among those cases in which a history of the early infection could be secured, the shortest time in which the thyroid became involved was two years and the longest was thirty years.

In 3 cases symptoms due to interference with the thyroid functions were occasioned, and in 2 of these the changes were those seen in myxedema, while in the third (Thompson's) symptoms of Basedow's disease were present—exophthalmos, tachycardia and albuminuria.

In a number of cases were present symptoms due to interference with the respiration and deglutition. In 2 cases dyspnea and dysphagia were present; in another these symptoms with hoarseness as well. One patient complained of dyspnea, stridor and cyanosis; another of dyspnea and coughing; a third of dyspnea alone. In another stridor was the only symptom, and in a fifth coughing alone. Lastly, the specimen in the Royal Museum showed a tracheal stenosis, and it is reasonable to suppose that there was some respiratory difficulty as a result of this. In the remaining cases respiratory symptoms were either not present or were not mentioned. Thus we see that in at least 9 of the cases, nearly 50 per cent., there were symptoms due to interference with the respiratory passages.

Clinical examination, operation or autopsy showed in 9 cases also there was actual pathology of the larynx, trachea or esophagus. Tracheal stenosis occurred three times, esophageal stenosis once and tracheal ulceration once. Recurrent paralysis was found twice, and in one of these cases the trachea was also pushed aside by the thyroid tumor. In one instance the trachea was fused with the tumor and in another the larynx was similarly affected.

Comparing the cases mentioned in the last two groups we find that in 1 case dyspnea and dysphagia were present, with no definite pathology mentioned, while in another, that in which the tumor was fused with the larynx, no symptoms of interference with respiration were noted. Thus in a total of 10 cases, practically 50 per cent. of the total number, there was present some interference with the organs of respiration or swallowing, or both.

The cases which came to autopsy all showed syphilitic involvement of other parts. In a total of 6 cases which were examined postmortem hepatic gummata were present in all, the spleen was involved twice and the kidneys once.

A consideration of the type of lesion of the thyroid gland showed that the usual tumor was a very hard growth, this type occurring seventeen times. In 9 of these 17 cases the tumor showed a nodular, uneven surface, while in 7 the surface was smooth. In the other cases the contour of the tumor was not described.

Of the remaining 5 cases the tumor was in 2 instances soft, while in the other 3 its consistency was not mentioned.

In 5 cases the tumor was apparently an enlargement of the entire gland; in 6 cases the right lobe alone was affected; in 3 the left lobe; and in 1 the isthmus and a small part of the right lobe. In 7 instances the location of the tumors in the gland was not given. The size of the tumors varied from that of a cherry to growths larger than an orange. In most of the cases the lesions reached a considerable size.

The skin over the tumors was involved by ulceration only twice and in only 1 case was pain a symptom.

In one case the gland was involved secondary to perichondrial gumma of the thyroid cartilage; in a second the process began in the larynx and extended to the thyroid. In all remaining cases the gland itself was first involved.

The response of syphilitic lesions of the thyroid to treatment is as prompt as is usual in syphilis of other parts. Most of the cases having been seen before the salvarsan era, mercury and potassium iodide or potassium iodide alone, had been used in the treatment, 11 cases being treated in this way, with complete recovery in all but 1. In this case the tumor disappeared under treatment with potassium iodide and mercury but soon recurred, and was resistant to these drugs. The use of salvarsan, however, produced a rapid disappearance of the tumor. In 1 case death resulted from the thyroid tumor, but the patient was almost moribund when seen, and no treatment had been instituted. Another case died as a result of other conditions, while Demme's cases of inherited syphilis all died, undoubtedly due to their general condition. One of Mendel's cases, after recovering from what was apparently a gumma of the thyroid, died of cancer of this gland. In 2 cases the tumor was extirpated before a correct diagnosis was made, while in 2 others no mention of treatment or its results was made.

A realization of the possibility of tertiary syphilis of the thyroid gland is important because of the close resemblance which the tumor bears to a malignant growth. In 5 of the cases in this series a diagnosis of carcinoma was made, with operation in at least 4 of them. In still another case operation was advised but not attempted, while in a number of other cases the correct diagnosis was only reached following the autopsy or operation.

The duration of the thyroid involvement varied in the different cases from two weeks to three years. In the majority of the cases the tumors grew rapidly until they reached a certain size and then persisted with little or no increase in size.

Histological reports were given in 12 of the reported cases, and while in the majority of them the diagnosis was rendered easy by a characteristic microscopic picture, in others the findings were less definite.

Demme contented himself with the statement that in the 3

infantile cases the changes in the thyroid corresponded to those usually seen in gummata of the liver, so we may assume that here the histological findings were characteristic of syphilis.

In the case of Barth and Gombault the tumor consisted of a caseous center surrounded by a thick wall of connective tissue, the latter showing a large number of embryonic connective-tissue cells and a few giant cells. There was also a small round-cell infiltration and some obliterating endarteritis. Fraenkel found only an infiltration of small round cells. As giant cells, plasma cells and obliterative endarteritis were all lacking it would have been impossible to have made a diagnosis of syphilis on the microscopic findings alone. The specimen exhibited in the Museum of the Royal College of Surgeons showed only a fibrous tissue richly studded with nuclei.

In Küttner's first case gross section of the gland showed some remnants of thyroid tissue near the periphery of the gland, but elsewhere the parenchyma of the gland had been replaced by a gray, homogeneous tissue containing nut-sized caseous nodules. Microscopically these nodules were seen to be surrounded by a zone of giant and lymphoid cells. In the second case he states that the findings were very suggestive of syphilis. But little of the stroma of the gland was present and there was a marked round-cell infiltration. Giant cells and necrosis were lacking, but some of the vessels showed a thickening of the intima and a round-cell infiltration of the adventitia. The capillaries showed a thickening and increase in number of the endothelial cells.

In one case of Mendel's in which sections were examined he found connective-tissue strands radiating from the periphery of the gland inward. Remnants of the thyroid tissue were seen at the periphery of the gland. The center was a structureless mass with some endarteritis present. About the caseous center was an intermediate zone of spindle-shaped and giant cells.

Specimens from Clarke's case showed a typical gummatous structure, with complete destruction of thyroid tissue. Poncet and Leriche found an inflammatory granuloma histologically, exhibiting large numbers of giant cells in the midst of cellular elements of embryonal aspect. No endarteritis was present. The granuloma was so acutely inflammatory that in this respect it resembled syphilis less than tuberculosis. Davis, with a large quantity of material obtained at autopsy, was able to give a thorough description of the macroscopic and microscopic changes in his case. The thyroid tissue had been completely replaced in some places by a new growth, these areas as a rule being sharply demarcated from the surrounding tissue. The tissue comprising the new growths was divided into two zones, the outer of which was made up mainly of large spindle-shaped cells in a myxomatous matrix, but included also a few large stellate and epithelioid cells, and several giant cells. The inner zone was composed of necrotic material, with a few large

spindle, stellate and endothelial cells. Davis felt that the histological diagnosis was unquestionably syphilis.

SUMMARY. 1. Gummatous syphilis of the thyroid gland is of rare occurrence.

2. Women are more frequently the subjects than men.

3. The cases so closely resemble carcinoma clinically that a differential diagnosis on these grounds alone is often impossible.

4. The usual change is a hard, nodular or smooth tumor involving either lobe, the isthmus or the whole gland.

5. Symptoms due to thyroid disturbance are unusual, and when they occur are those of myxedema, or apparently rarely those of hyperthyroidism. Symptoms due to interference with respiration are very common, and may be so severe as to cause death.

6. If the patient is seen before death is imminent and anti-syphilitic treatment instituted the prognosis is very good.

I wish to express my appreciation to Prof. Udo J. Wile for the privilege of reporting this case and for his invaluable criticism.

THE DIFFERENTIAL DIAGNOSIS OF AFFECTIONS OF THE RIGHT UPPER QUADRANT.*

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THE differential diagnosis of affections of the right upper quadrant resolves itself into an interpretation of the various forms of "dyspepsia." Dyspepsia, however, is such a protean condition and arises from so many widely divergent causes that its translation into clinical entities is usually difficult. In the phylogenetic development of the gut tube there has come about a radical subdivision in morphology, physiology and function, and the stomach gives forth reflex symptoms from a variety of diseased organs more or less remotely situated.

In an analysis of indigestion we find that approximately 40 per cent. are due to disease within the abdomen but arising from other organs than the stomach: that 40 per cent. are due to causes entirely without the abdomen and that only in 20 per cent. is there organic disease of the stomach.

Vander Hoof[1] analyzed the cause of indigestion in 1000 cases and found that appendicitis was the causal factor in approximately 25 per cent., cholecystitis in 10 per cent., peptic ulcer in 10 per cent., neurosis in 10 per cent., cancer in 5 per cent., visceroptosis,

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intestinal stasis in 10 per cent., while miscellaneous affections of the kidneys, lungs, eyes, etc., constituted approximately 30 per cent. It is a sad diagnostic commentary when 97 out of 1000 tabetics have had a laparotomy for a supposed intra-abdominal lesion,[2] 19 for gastric ulcer, 19 for gall-stones, 18 for appendicitis and 13 for salpingitis, etc.

Cabot[3,4] found from a study of 1000 autopsies at the Massachusetts General Hospital and a comparison with the clinical findings that in gastric cancer a correct diagnosis was made in 72 per cent. In peptic ulcer, including both gastric and duodenal, a correct diagnosis was arrived at in only 26 per cent.

The very marked advance in the technical efficiency of roentgen diagnosis in the last few years shows how rapid has been our diagnostic progress with 67 per cent. correct diagnosis in duodenal ulcer and 80 per cent. correct diagnosis in gastric ulcer,[5] while 95 per cent. of gastric carcinoma are diagnosticated by this means.[6]

For all ordinary purposes of diagnosis we rely upon the history which still remains the keystone in the diagnostic arch of affections of the right upper quadrant. Clinically our problem is to differentiate gastroduodenal ulceration, gastric carcinoma, disease of the biliary apparatus, including pancreatitis, appendicitis and to a lesser extent lesions of the kidney and colon.

If we conceive the stomach as exercising properly two main functions, that of motion and secretion, we would reasonably expect that any ulcerative condition in the beginning before active infiltrative changes had occurred would manifest itself by aberrations either in the motor or secretory functions of the stomach. Is there anything distinct in the evolution of gall-bladder disease that demarks it from the evolution of peptic ulcer? Is there anything in the history of chronic appendicitis wherein it differs in sufficient degree to enable us to differentiate reflex gastric distress of appendicular origin from dyspepsia of gastroduodenal ulcer? We believe that the single factor of greatest importance in differential diagnosis is a carefully taken history. The history should be a citation of the facts of the disease from its beginning and in the order of their occurrence, and if properly taken should provide a means of making a clinical diagnosis. By clinical diagnosis we mean that the nature of the pathological process is determined with relative anatomical localization. It is obvious that one of the most prominent factors in the diagnosis of affections of the right upper quadrant is the correct interpretation of the discomfort and pain for which a patient usually consults a doctor. There are certain fundamental characteristics of abdominal pain—its onset, localization, point of election, maximum point of tenderness and the various paths of radiation and reflexion which are of great value in diagnosis, for within their group most of the affections that we must differentiate run true to type. First, let us take up the consideration of affec-

tions of the biliary tract. We prefer to use this generic designation rather than gall-stones, for gall-stones are an incident dependent upon the virulence of the infection. The gall-bladder, the liver, the pancreas and the stomach are embryologically, anatomically, physiologically and pathologically closely related, and should be considered as one physiological system.[7] Infection is the pathological activator of disease of the biliary apparatus, and while it is true that a gall-bladder may be sterile and yet contain stones, infection must have been present at the time the calculi were originally formed. In disease of the gall-bladder only approximately 75 per cent. are associated with stone, the other 25 per cent. represent varying degrees of infection not associated with the formation of calculi. Irrespective of the presence of calculi in disease of the gall-bladder the histories of a large number of cases will be found to present a composite picture in which four well-defined pathological stages are evidenced and which clinically may be translated into four sequential clinical pictures: (1) When the disease is confined to the gall-bladder; (2) when there are attacks of biliary colic; (3) when calculous obstruction to the common duct intervenes with jaundice; (4) when as a result of infection or trauma to the common duct there is an associated or coincident disease of the pancreas.

The early symptoms of gall-bladder disease are vague atypical symptoms of a qualitative dyspepsia. This dyspepsia conforms to no rule, exhibits no periodicity in its onset, and is characterized by variations in the degree of gas production, eructations, sense of fulness and weight or oppression with occasionally tenderness along the right costal margin. There is a characteristic chilly or goose-skin sensation after dinner and occasionally a slight catch in the breath, particularly on the right side, suggesting a pleurisy. This gastric irritability is made worse by greases, fried foods, apples, cheese and gas-producing carbohydrates in general. Occasionally there is an entire cessation of this indigestion, with prolonged periods of comparative gastric relief. After a variable period of time there is introduced into this picture an acute attack of pain, colicky in type, with marked predilection for nocturnal occurrence, and lasting four to six hours, and usually so severe as to require a hypodermic of morphin. This colic comes on without premonition or warning, although there is occasionally a suggestion of an aura in an unusual state of well-being.[8] Its marked and distinct characteristic is that it is of maximum intensity, occurs spontaneously, like lightning, has a short duration, disappears spontaneously, leaving a residual soreness along the right costal margin. The third clinical picture is due to calculous obstruction of the common duct and introduces for the first time the presence of jaundice. There may be a preceding history of gastric distress, interrupted by periods of colic and during one of these attacks of

pain there is a sudden onset of jaundice which reaches a maximum intensity in twenty-four to forty-eight hours, and is associated with a febrile reaction usually so distinct as to suggest a malarial paroxysm with its chill, fever and sweat. This febrile reaction is so short as to give a characteristic intermittent or remittent fever variously described as "steeple-chart" temperature,[9] or the angle of cholangitic infection.[10] When we have a colic associated with jaundice and marked by fever, leukocytosis, etc., and occurring in that order we are warranted in making the diagnosis of calculous disease of the common bile duct.

It must not be forgotten that a calculus which is capable of passing through the cystic duct may pass throughout the common duct into the duodenum without producing any further trouble. There is, however, a great tendency for a stone in the common duct to become lodged at the ampulla of Vater and by accretions of pigment to increase quite rapidly in size. Whether from the presence of stone or the infection or both[11] it was early observed that there was a very marked association between affections of the biliary tract and pancreatitis.[12]

It is interesting to recall that in reporting the statistics of the Mayo Clinic[13] it was found that in 2611 operations on the gall-bladder the pancreas was involved in 7.6 per cent. In 325 operations on the common duct the pancreas was involved in 22 per cent. and in 168 operations for disease of the pancreas 81 per cent. were accompanied by or due to gall-stones. A number of men, Archibald,[14] particularly, have gone so far as to claim chronic pancreatitis is a common abdominal complaint and capable of diagnosis. "Given a case with acute abdominal pain referred chiefly to the upper half of the abdomen, if upon examination one finds the greatest tenderness located in the epigastrium about midway between the umbilicus and the ensiform cartilage, extending perhaps 1 inch or 1½ inches to the right, and in particular a similar distance to the left also, while absent over the gall-bladder region, if further in the history there are absent symptoms of gastric or duodenal ulcer, and there is no evidence of intestinal obstruction, then this case is in all probability one of pancreatitis."[14]

The clinical differentiation of acute pancreatitis is sometimes difficult and the description of Fitz[15] is even today the best epitome upon its diagnosis. "Acute pancreatitis begins with intense pain, especially in the upper abdomen, soon followed by vomiting, that is likely to be more or less obstinate, and not infrequently slight epigastric swelling and tenderness, accompanied with obstinate constipation. A normal or subnormal temperature may be present and symptoms of collapse precede by a few hours death, which is most likely to occur between the second and fourth day."

The history of pancreatic or biliary carcinoma is distinct. The genesis of tumors requires time and the history of the onset of

jaundice is succinct and characteristic. By slow growth a neoplasm produces from day to day only minimal changes, whereas vascular or inflammatory processes produce extensive changes within a short time. Neoplasms of the biliary apparatus, the pancreas or the contiguous portion of the duodenum early invade or compress the termination of the bile and pancreatic ducts. Jaundice develops imperceptibly and without pain, so that from day to day it seems hardly to advance in intensity, but without pause or hesitation, without intermitting or remitting, it progressively deepens in intensity from mild to severe, from lemon to black, until it becomes the typical icterus melas. Its evolution is not associated with colic and in its earlier stages is usually devoid of pain. It is not associated with chills, fever or sweats nor leukocytosis. With such a history, malignancy is the probable diagnosis, and when this history is associated with a palpable or distended gall-bladder the diagnosis is almost positive. One of the few diagnostic laws that has stood the acid test is Courvoisier's law. Courvoisier enunciated his law: "In cases of chronic jaundice, due to blocking of the common duct, a contraction of the gall-bladder signifies that the obstruction is due to stone: A dilatation of the gall-bladder, that the obstruction is due to causes other than stone."[16]

In reporting the cases of the Massachusetts General Hospital, Cabot[17] found that "in 86 cases of obstruction of the common duct 57 were due to calculous obstruction and in 47 the gall-bladder was atrophied, in 8 it was normal and in 2 enlarged. In 29 cases the obstruction was due to causes other than stone. In 27 the gall-bladder was diseased and in 1 the gall-bladder was empty and in 1 contracted around the calculi; 4 cases only of this series were exceptions to Courvoisier's law. With the exception of these 4 cases which constituted only 5 per cent. of the total number examined every record of the Massachusetts General Hospital series in which definite statements are to be found concerning the points at issue goes to confirm Courvoisier's law."

Peptic ulcer is a distinct organic ulceration of the gastroduodenal portion of the gut tube, and within its type the symptoms are constant and, as a rule, characteristic. Variations in symptomatology depend to a considerable extent upon the localization, since 70 per cent. of all peptic ulcers are located so as to interfere with the emptying power of the stomach. In the diagnosis the history is all important. Palpation, percussion and auscultation give evidence of very limited value; chemical examination of gastric contents give some confirmatory value only. The presence of gastric blood will be absent in over 75 per cent. of cases while roentgen-ray examination is positive in 67 to 80 per cent. of cases of duodenal and gastric ulcer respectively. With clinical methods alone we are able to make a correct diagnosis in 80 per cent. of cases. Three

facts stand out in the history of all regular cases of peptic ulcer: (1) Pain; (2) time relation of pain to food ingestion; (3) periodicity of attacks.[18]

In all true ulcers in their symptom-producing stage a given set of symptoms are present or are introduced by certain articles of food or have a certain time interval in relation to the ingestion of food. These symptoms are constant and the interval or period is definite. If beefsteak produces pain upon ingestion then beefsteak during the symptom-producing stage always produces pain quite distinct and characteristic from the neuroses which intermit in their relationship from day to day. In ulcer if the pain is produced one hour after the ingestion of meat that interval is usually constant for the type of ulcer. Now, biologically in the beginning an ulcer manifests itself by irritations of the functions of the stomach and there is the interference or an irritation in the secretory motor functions, and there is the clinical condition of hyperchlorhydria from increased secretion or qualitative changes in acidity, and in the beginning there is usually hypertonus, hyperperistalsis and hypermotility.

The ingestion of food under normal circumstances is accompanied by a reflex process which is not perceived—a subconscious reflex—and when pain arises from the ingestion of food it points to an irritable process of the cord through which these reflexes pass as a result of oft-repeated painful stimuli. The epigastric region is essentially the place to which sensory symptoms are referred and the upper part of the left rectus muscle usually contracts first in response to an irritation from the stomach.[27]

A long history of gastric trouble associated with pain in the lower part of the epigastrium would suggest pyloric stenosis. We may therefore say that the patient with a gastro-duodenal ulcer presents in the main a history characterized by (1) pain, bearing some relation to the ingestion of food and the quality of food; (2) a chronicity; (3) the periodicity or the repetition of symptoms day after day during the symptom-producing period of the ulcer. As a corollary to these three are certain variant characters for certain types of ulcer; the nocturnal pain of duodenal ulcer and its rather specific type of hunger pain. Pain in ulcer follows the ingestion of food after a definite interval which is marked by the order and precision of its occurrence and its persistent occurrence throughout the whole history of the case.[21]

The complex of chronicity and the periodicity of attacks with pain or distress, repeated uniformly day by day during the attack and bearing a fairly definite relation to food intake and control is of primary clinical importance to the diagnosis of 80 per cent. of cases of uncomplicated peptic ulcer. In the remaining 20 per cent. this complex may be irregular, atypical or almost entirely absent, or the symptoms may be mixed, owing to coincidence of

disease of contiguous organs which occurs in about 20 per cent. of all cases of ulcer.[19] In the irregular or atypical 20 per cent. the roentgen-ray examination with a bariumized carbohydrate meal is of great value: (1) By deformities of luminal contour; (2) by the triad of hypers—hypertonus, hyperperistalsis and hypermotility,[20] and of lessened value the determination of aberrations in gastric chemistry.

If an ulcer is situated on the lesser curvature near the cardiac end the symptoms are different than when located at the pylorus or in the duodenum. The symptoms of ulcer near the cardiac end will be those of pain, shortly after eating, with periodicity in its production, with the vomiting of partly digested food, with blood in the vomitus, with a progressive emaciation because the patient does not retain his food. With ulcers involving the pylorus there is soon introduced relative pyloric stenosis from spasm and secondary absolute pyloric stenosis from infiltration and spasm and the symptom of pain after the ingestion of food, when this interval gives place to the vomiting of large quantities of fermented material with food remnants. In the pyloric type of ulcer there is, as a rule, a loss of weight and secondarily a cachexia from absorption of fermented and putrefying gastric content. Now, quite distinct from these two types is that of the duodenal ulcer where the patient is, as a rule, well nourished and when he has food in his stomach is without distress.

Turning to duodenal ulcer, specifically we are in full accord with Moynihan that "persistent recurrent hyperchlorhydria is duodenal ulcer."[21] In gall-bladder disease, pain and discomfort usually come on with eating, while in duodenal ulcer the pain is relieved by eating. In duodenal ulcer the food that gives pain in pyloric ulcer gives relief in duodenal ulcer. The patient with duodenal ulcer, usually a man, is ordinarily a well-nourished individual, with marked appetency for food and who informs you that if he could eat all of the time he never would have a bit of pain. Consider his daily history: He starts out in the morning, eats a good breakfast and about 11 o'clock gets a pain, a pain that is usually described as gnawing, persistent and rather severe, but one that is tolerated. He seldom requires anodynes. He eats a sandwich or drinks a glass of milk and the pain disappears. The pain usually comes on when his stomach is empty and at about the time that he is naturally hungry. For this reason it becomes known as hunger pain. At about 4 o'clock the pain recurs and he takes another light lunch with rapid cessation of pain. Returning home he eats a well-proportioned supper, and before going to bed has a few crackers and a glass of milk. Sometimes about 12 o'clock he is awakened by epigastric pain of the previous type, but rather more severe. Repeated experience with the night pain has made it necessary to have some crackers or a piece of chocolate at his bedside. Upon

eating something or taking soda the pain disappears. This history is repeated day after day with unvarying precision and consistency. Its story is typical and the diagnosis might be made as Moynihan expresses it "by correspondence."

The value of test meals is of confirmatory value only. In order of importance are: (1) food remnants, (2) blood, (3) acidity of test meal.[26]

In considering cancer of the stomach one may say that it makes its presence known only when ulceration occurs or when there is an interference with motor function of the stomach. The history is of most value in suggesting or arousing the suspicion of malignancy. There is, however, no isolated or significant sign or symptom upon which the diagnosis of early cancer can be predicated. The diagnosis of early cancer depends upon the mechanical interference produced, and it is an accident if the location of the growth is such as to introduce early the element of stenosis. If there is any symptom which stands out as between ulcer and cancer it is the known presence of periodicity of symptoms in ulcer and its absence in cancer. Periodicity is present in about 85 per cent. of ulcers and is absent in 99 per cent. of cases when that ulcer becomes malignant.[22]

Cancer of the stomach occurs in three forms: (1) The man who is perfectly well, who has an athletic stomach and who has never had any previous gastric distress. There comes into his history an abrupt sudden development of gastric signs. His symptoms suggest an acute ulcer of the stomach, with hemorrhage, but at the end of three or four weeks the man has lost physically beyond what would be expected of a simple ulcer. His anemia has become more pronounced, with a distaste or aversion for food, and finally from the anemia, emaciation and beginning cachexia the diagnosis of rapidly growing carcinoma is made. This type constitutes about 30 per cent. of all cancer cases and has an average duration of eight to ten months. The second class, and by far the largest proportion of about 60 per cent., is represented by the patient who has a perfectly clear history of chronic gastric ulcer extending over a period of years. A form of gastric distress characterized by periodic discomfort or pain usually bearing a distinct relationship to food ingestion with some vomiting. His previous gastric history covers a period of eight to ten years, with intermittent attacks of typical ulcer history. Finally, there comes an attack from which he does not respond to the medical treatment that heretofore has proved beneficial. The pain becomes constant, marked distaste for food intervenes with particular aversion to meat; blood is constantly present in the stool and vomitus and he has an average duration of cancer symptoms approximating six months. The third class, of about 10 per cent., is represented by the patient who has a typical history of gastric trouble from which

he nearly but never quite recovers, and after a variable period progressively, but very slowly, becomes worse, with a distinct distaste for food and without any interruption progresses to a well-defined cachectic condition of malignancy.

No paper on affections of the right upper quadrant would be complete without considering chronic appendicitis. The commonest site of a "gastric ulcer" is the right ileac fossa.[21] In my personal experience at least 18 per cent. of cases coming to laparotomy have two lesions, either one of which offers an operative indication.

"Appendix dyspepsia" is a varied and indistinct clinical picture. It is usually more difficult to diagnose than either the conditions of ulcer or disease of the gall-bladder. If one can eliminate either of the two conditions named above it would be possible to arrive at a diagnosis of appendicular dyspepsia by elimination. In the ordinary case there is usually an absence of a history of an acute attack. Epigastric distress is a constant annoyance or sense of ache and usually with no distinct relationship to food. The pain or distress is apt to be aggravated by activity and motion and is occasionally relieved by an enema or a cathartic. It is infrequent for appendicular dyspepsia to be associated with a history of acute attacks, although occasionally local appendiceal pain may be elicited.

The chronically diseased appendix induces reflex gastric disturbances and usually contains fecaliths. The mechanism of disease is probably in a large majority of cases a pylorospasm with pain, vomiting, increased secretion, increased acidity, gaseous and sour eructations. It is noteworthy that the pain and distress is usually more prolonged than similar occurrences in disease of the gall-bladder. The distress is usually associated low down in the epigastrium or about the navel and lacks the distinct characters of localization as in biliary disease.

The outstanding features in the genesis of appendicular dyspepsia are its irregularity, variability and almost entire lack of periodicity. Food that at one period is associated with gastric irritability is upon another occasion eaten with zest and no distress. The attacks are distinctly less regular in their symptomatology than in ulcer.

It is interesting to note that McCarty[28] reported 59 cases when both the gall-bladder and appendix were removed and that 69 per cent. of the appendices showed distinct pathological changes. The ordinary postmortem incident of disease of the appendix is approximately 17 per cent.[25] Furthermore, in operations for cholecystitis 52 per cent. were associated with disease of the appendix, and in cholelithiasis 44 per cent. had distinct pathological changes in the appendix.

Paterson[23] found appendicular disease in association with gastric ulcer in 54 per cent. of cases and with duodenal ulcer in 66 per cent. of cases. Hutchinson[24] records 24 cases of fatal hemorrhage from

the stomach after operations of various kinds upon the abdominal viscera. Of these 24, 21 were cases of appendicitis with septic complications. I have records of 4 cases of pronounced gastric hemorrhage which on very extensive abdominal exploration revealed no morbid process except in the appendix, and following an appendectomy there was a cessation of gastric distress and gastric hemorrhage.

Gastric hemorrhage has been experimentally produced by Rogers by injecting chemical irritants into the cecum and ascending colon, while irritation of the colon, *per se*, has been shown to bring about a gastric stasis and the delayed passage of food material through the small intestine.[29]

Barclay[30] quite recently has drawn attention to the spasmodic closure of the pylorus following reflex stimulation from the terminal ileum, when there is a too rapid overloading of the small intestine with chyme. Biologically the ileocecal valve represents a great point of chemical and bacterial partition, for at the cecum we have a change in chemical reaction; maximum bacterial flora, maximum fluidity, anastalsis, predominant lymphoid tissue and a point of natural or normal stasis.[31] These observations would seem to offer proof of a very extensive system of intra-alimentary reflexes acting upon the pyloric mechanism, and it would serve to explain the incidence of appendicular dyspepsia.

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ROENTGEN RAYS AS AN AID IN THE DIAGNOSIS OF ULCUS VENTRICULI.

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When Cannon visualized the stomach in the animal by feeding it on food mixed with bismuth subnitrate, and Rieder introduced the bismuth meal for the same purpose in the human being, it was hoped that ulcer and cancer of the stomach would be absolutely accessible to diagnosis. While such hope was realized to a fair extent it cannot be too strongly emphasized that in the great majority of cases, especially of ulcer of the stomach, roentgen rays alone without the other clinical methods may quite often be misleading.

Roentgen-ray diagnosis of the diseases of the gastro-intestinal tract in general, and of ulcer of the stomach in particular, owes its development primarily to the Continental workers, notably among whom are to be mentioned Rieder, Holzknecht, Faulhaber, Kreuzfuchs, von Bergmann, Levy-Dorn, Barclay, and Hertz. Not long afterward the Americans began their very painstaking work, and here rank the names of Case, Carman, Pfahler, Jordan, Skinner,

Cole, George, Hirsch, Holden and others. Comparing the aims and accomplishments of European workers with those of our country, one notices throughout that while in Europe most roentgenologists in studying the diseases of the gastro-intestinal tract made every effort to interpret their findings according to the disturbed function caused by existing pathological lesion, in this country more importance was originally attached to structural changes in the roentgen-ray interpretations.

Among the American authors who independently utilized the functional methods of roentgen-ray diagnosis in the study of gastro-intestinal diseases are Case, Carman, Mills, Skinner and Hirsch.

Accordingly, two methods are employed: the indirect method, by which we determine a lesion in the gastro-intestinal tract, based on disturbed function, and the direct method, which bases the diagnosis of a lesion on existing structural changes. Both have their respective usefulness.

From the clinical stand-point, however, there is no doubt that the roentgen studies based on disturbed function (indirect method) are outweighing in importance the direct method. It is an established fact that the patient's complaints are in proportion to the disturbed function of a particular organ. Based on such complaints, plus a thorough physical examination, one establishes a proper diagnosis. The clinician who finds himself so frequently confronted with difficulties, especially when dealing with diseases of the abdominal viscera, at once asks, Will roentgen-ray examination give us information of additional value to make a definite diagnosis when the symptom-complex and the rest of the physical and laboratory examinations have left us in doubt? This, as will be shown, has been realized to a considerable degree.

In the roentgen-ray diagnosis of ulcer of the stomach we seek to determine whether we are dealing with a simple or a complicated lesion. Approaching the roentgen-ray diagnosis of simple ulcer of the stomach from the stand-point of disturbed function (indirect method), we must have a clear understanding of the normal function of the stomach as seen roentgenologically, and hence a brief consideration of the roentgenological physiology is essential.

Roentgen-ray examination enables us to study with exactness the following physiological phenomena:

1. Position and form of the stomach.
2. Tonus and peristalsis.
3. Gastric secretion.
4. Mode of filling and motility.
5. Mobility.

1. Position and Form of the Stomach. In the great majority of people the stomach lies to the left of the median line, with the exception of the pars pylorica, part of which lies to the right of the median line. The greater curvature in the standing position is

usually either on the line with or 1 or 2 cm. below the crest of the ileum. In a lesser number of cases the stomach lies high in the abdominal cavity, with the pars pylorica entirely to the right of the median line, even part of the corpus to the right. The first more frequent position gives us the form described by Rieder (Fig. 1) as the pipe-shaped stomach, called by Groedel the siphon stomach; the second the less frequent (Fig. 2) is termed by Holzknecht the bull-horn stomach.

FIG. 1.—Pipe-shaped stomach.

FIG. 2.—Bull-horn stomach.

The form and position of the stomach, as shown in the accompanying figures, not being uniformally found in normal individuals, has given rise to considerable discussion by both clinicians and roentgenologists. Such discussions seem justified because the roentgen-ray stomach does not correspond in position and form to that described by the anatomists. This has led no less an authority than Stiller to state that a stomach when containing food with a contrast substance does not exemplify a normal stomach. Roentgenologists again have widely differed in their opinions as to what form is to be considered normal from the roentgen-ray stand-point. Groedel, for example, claims that the roentgen-ray stomach, with the individual standing, cannot be compared with the stomach described by the anatomists, because the latter have always seen the stomach in the cadaver with the corpse in the horizontal position. From such assertions it is evident that the difference in shape and form of the stomach, according to Groedel, is chiefly dependent on the position of the individual and the passive filling of the organ. While this is true to some extent it will be shown below that such an exclusive view leads to erroneous conclusions.

A much more enlightened contribution as to what constitutes a normal form and shape of the stomach and the factors that enter into their formation has been furnished by the laborious work of Forssel. Forssel's work and conclusions we intend to analyze in detail. It seems advisable, however, to name first and demonstrate

by figures the most important roentgenological division of the stomach.

The well-known anatomical division into fundus, corpus and pylorus had to be modified when the stomach was visualized roentgenologically. In view of the fact, however, that different roentgen-

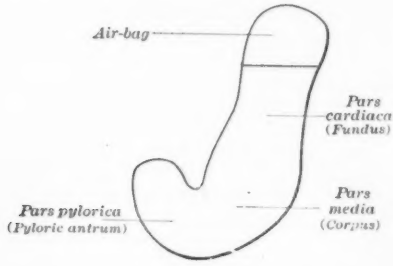

FIG. 3

ologists describe different forms and shapes of the stomach, even in a normal state, a uniform division has not yet been agreed upon. Holzknecht and Huerter divide the stomach into fundus, corpus (pars media) and pars pylorica (Fig. 3). Groedel's division is pars descendens and sac and pars ascendens (antrum and pylorus).

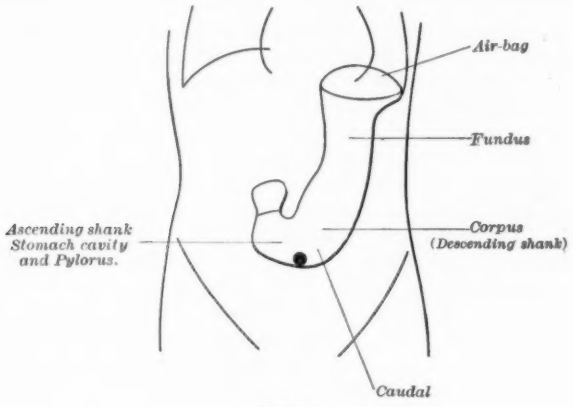

FIG. 4

The uppermost part of the stomach he terms the cranial portion and the lowermost part the caudal portion (Fig. 4). The Holzknecht, Huerter and Groedel division are not exact because the uppermost part, named fundus, would be in reality a fundus only if the individual stood on his head. Holzknecht and Huerter as

well both speak of a pars media and pars pylorica, and ignore the caudal part or connecting link (a very important part to be shown later). Groedel, who speaks of the descending and ascending part, presupposes an ascending portion in every stomach, whereas it is well known that the bull-horn (Holzknecht) type has no ascending part. Furthermore, the connecting link he terms magensack (sac of the stomach), which would imply a passive portion of the stomach when filled with food. In reality that part of the stomach is a very active one.

The objections outlined as to the loose description of roentgen-ray form and position of the stomach, as well as its divisions, are overcome by the painstaking anatomical and physiological studies of Forssel, who showed that the form and the position of the stomach are solely dependent on the work of the musculature of the stomach. E. Schlesinger expressed the view long before Forssel that the form of the stomach depends on its tone, and Holzknecht built up on this basis the classification into ortho-, hyper-, hypo-, and atonic types. Useful as the suggestion of Schlesinger seemed to be, it was soon evident that his work and even the classification of Holzknecht expressed just a visual appreciation of the form without consideration as to the underlying mechanism which constitutes the different forms.

We follow the reasoning of Forssel to show that form and position are dependent on the muscular architecture of the stomach, because an understanding of this architecture is essential to an intelligent interpretation of the fluoroscopic or roentgenographic appearances of the stomach. Forssel showed that the vertical part of the stomach (termed fundus and pars media by Holzknecht and others) has for its support the strong musculature which runs vertically from cardia to antrum, nearer to the lesser than greater curvature, *i. e.*, excentrically. This musculature forms the well-known groove of Retzius (Magenstrasse of Waldeyer or sulcus gastricus) (Fig. 5), where the food is distributed to the vertical part of the stomach. The musculature forming the groove is therefore the fixed supporting axis around which the musculature of the rest of the vertical portion of the stomach is grouped. The musculature forming the fixed point, situated as it is nearer to the lesser curvature than to the greater, allows distention of the stomach almost exclusively toward the greater curvature, and is therefore responsible for the asymmetry of the vertical portion of the stomach. The lower part of the stomach (pars pylorica), the musculature of which is grouped centrally around its axis, runs transversely in a symmetrical manner. This gives that part of the stomach a tube-like form.

According to Forssel the supporting apparatus of the stomach consists of a vertical and a transverse portion. The vertical apparatus is formed by the median and external layer of the longitudinal bundle as well as a supporting loop of the inner layer;

the transverse portion is formed by the ligamentum transversalis of the transverse portion of the stomach. Besides the supporting apparatus residing in the musculature of the stomach proper, both portions of the stomach have supports from without. The vertical part is intimately connected with the cardia by the phrenicogastric ligaments; the transverse portion is supported at the pylorus by the hepatoduodenal ligament and the musculus suspensorius duodeni. From the anatomical stand-point the division into a vertical and a transverse stomach is very appropriate. Forssel as well as Cunningham, however, go further and divide the stomach according to its function (Fig. 6). The vertical or asymmetrical portion is designated as the corpus disgestorius and the transverse portion as the corpus egestorius. The caudal part forms the sinus and the incorrectly formed fundus is changed to the appropriate term fornix.

FIG. 5.—Retzius's groove.

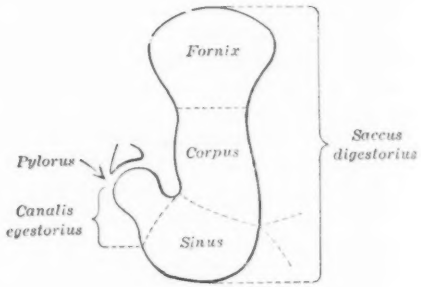

FIG. 6

The two types, bull-horn and siphon, are, according to Forssel, explained in the following manner: The typical changes in the form of the stomach depend on whether the entire corpus digestorius or the sinus alone is in the state of contraction. By contraction of the sinus the stomach approaches the form of a uniformly bent tube or so-called bull-horn type. It is this form which shows the strongest contractions (hypertonic type, Schlesinger). As the supporting apparatus of the vertical portion of the stomach participates in the contraction it brings the entire organ into a higher position, and we therefore find the lower border above the umbilicus. We meet this form in individuals who have a broad thorax with a wide aperture (hypertonic individuals, status apoplecticus), also where there is an increase of intra-abdominal pressure, as in obesity, meteorism, ascites, pregnancy, and when the patient is in the horizontal position. In all such individuals, however, it is not the displacement of the stomach by its surrounding organs but the

stimulus from without which causes excessive contractions in the entire corpus digestorius, bringing about a bull-horn form. When the contractile power of the musculature is lost the bull-horn form cannot be produced by any outside influences. The infant stomach, which is usually of this form, is explained by the stimulating influence of the large liver and distended bowels during the first months of life. The siphon form of Rieder is brought about by the uniform contraction of the entire stomach. Such a stomach has the greater curvature at 1 or 2 cm. below the umbilicus, an outspoken incisura. The lowest part of the stomach is formed by the sinus. This type is found with the greater part to the left of the median line, only the pylorus reaching the median line, or 1 or 2 cm. to the right.

Which of the two forms shall be considered roentgenologically normal? This can be answered only if we compare the form of the stomach to the status of the individual. Finding as we do the transverse stomach at an early age, up to ten years, as well as between forty-five and sixty, the explanation suggests itself that the stomach will tend to assume the transverse position during those periods, when the individual has a tendency to grow in width rather than in height. In childhood, growth in width consists of the bony and muscular as well as adipose tissue, while after forty-five it is mainly the adipose tissue that determines the increase in width. Whatever it is, the increase of abdominal and intra-abdominal pressure stimulates the stomach musculature to increased contraction, bringing about a transverse position. This is further aided by the high position of the diaphragm through which the external supporting points of the stomach (esophagus and hepato-duodenal ligament) are carried upward. During the age of growth —ten to twenty, with its predominating development in height— and the age of overactivity—twenty to forty-five, with no tendency to add fat—the vertical stomach (Rieder) is the normal. If a transverse stomach situated high in the abdomen is met in individuals of the status apoplecticus it is a normal form for that status. In individuals, on the other hand, who belong to the status asthenicus the long stomach with the greater curvature almost on the symphysis pubis is normal for that type.

It is an established fact that both forms, because of the status, may predispose to organic diseases of the digestive organs, but primarily the organs are not diseased. The transverse stomach predisposes to duodenal ulcer, the very long stomach to a gastric ulcer.

2. Tonus and Peristalsis. A proper understanding of the physiology of peristalsis, its function and its results, is absolutely essential to an appreciation of the changes in the peristalsis of the stomach under pathological conditions of the digestive organs.

As stated above, the stomach is divided, according to Forssel

and Cunningham, into two main compartments. Forssel calls them pars digestorius and pars egestorius, while Cunningham names them cardiac and pyloric portions. These portions are subdivided, Forssel dividing the pars digestorius into a fornix (pars cardiaca) terminating at a point corresponding to incisura cardiaca; corpus, extending from incusura cardiaca to the incisura angularis; sinus, from incisura angularis to antrum pylori. Pars egestorius consists of the antrum pylori. Cunningham speaks of the pars cardiaca as the sac of the stomach. The corpus he terms tube and the rest is the pyloric portion.

Before we proceed, let us take up briefly the term antrum. The anatomists and physiologists originally thought that the pylorus was separated from the stomach by a sphincter similar to that of the pyloric sphincter, but later a close study of the pylorus by anatomists failed to demonstrate the existence of a sphincter. They found that on the lesser curvature distal to the incisura angularis there is a thickened transverse band of musculature, at which point on the lesser curvature and opposite to which on the greater curvature the contraction wave is deeper. According to the excellent observation of Cannon this deepening never, under normal circumstances, completely separates the pylorus from the rest of the stomach, hence he has rightly named this part "vestibule" instead of the meaningless term antrum pylori. Cannon's findings are still further substantiated by the cinematographic studies of Rieder, Koestel, Rosenthal, Cole and others.

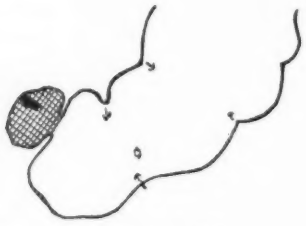

FIG. 7.—Peristalsis.

Peristalsis as seen Fluoroscopically. If we observe fluoroscopically the taking of food we note the following as regards normal peristalsis: After the first morsels have reached the vestibule a contraction takes place at the transverse band on the lesser curvature and a similar one at a point opposite on the greater curvature. This peristaltic wave, which we term the initial wave, is a response to the gastric secretions brought about by the act of chewing (appetite juice, Pawlow). Now, as the stomach fills up, we notice a state of repose lasting from four to six minutes, during which no peristalsis is seen in any part of the stomach. After that the regular

peristaltic waves set in. The wave begins at a point on the greater curvature opposite the incisura cardiaca (Fig. 7), running along the greater curvature, forming shallow waves. At a point opposite the incisura angularis the wave deepens. Distal to the incisura angularis, *i. e.*, at the beginning of the vestibule there is a still deeper contraction on the lesser curvature with a correspondingly deep contraction on the greater curvature opposite this point. This contraction lasts longest and achieves a depth almost simulating a division of the stomach into two compartments. In reality, as rightly pointed out by Cannon, a complete separation does not exist under normal conditions. The last two waves named are in fact persisting contractions, the object of which will be discussed later.

The waves do not go any farther than the pyloric ring because of the hiatus between the circular muscular fibers of the stomach and duodenum. Peristaltic waves take place four to six each minute. The part of the stomach above the incisura cardiaca (fornix, cardiac sac) possesses no peristalsis, only a peristole (Stiller) which exercises a firm grasp on its contents. Along the lesser curvature only superficial peristaltic waves are usually observed.

Corresponding to the visualized waves in different parts of the stomach it was experimentally demonstrated by Moritz that there is a difference of the intragastric pressure in the different parts. In the cardiac end it amounts to 6 to 8 cm. water and in the pyloric from 30 to 60 cm.

The importance of the peristaltic waves in relation to gastric digestion is still disputed. The earlier physiologists, Beaumont and Elkin, and some of the more recent workers, like Hofmeister and Schuetz, assert, on the basis of their experimental work, that the peristalsis in the corpus from incisura cardiaca to the vestibule of the stomach is mainly concerned with churning and mixing of the food, whereas the pylorus merely expels the food.

Cannon was the first to take an active stand against the older teachings that the digestive process goes on mainly in the corpus. He correctly stated that the experiments of the earlier observers produced pathological conditions of the stomach, and hence their conclusions are not physiologically correct. Cannon derived his conclusions from his observations on animals and human beings by means of the roentgen rays, and so his findings correspond nearest to physiology. According to Cannon the fornix (sac) serves as the actual reservoir. From the sac the food is advanced into the tube by the action of the diaphragm, aided by respiratory movements. In the tube (corpus) the food is mixed with the acid secretion and by peristaltic waves is carried acidified to the vestibule (pars pylorica). Part of the food in the tube is squirted back into the reservoir.

In the vestibule, therefore, according to Cannon, active digestion

and churning of the food goes on. According to the same author also, the sac forms the largest part of the stomach in the course of digestion and the tube the thinnest part.

While Cannon has ingeniously attributed to the sac the property of a reservoir in contradistinction to the tube which serves as a motor, we find that he does not account for the part of the stomach between the incisura angularis and the beginning of the vestibule (see Fig. 6), both ends of which are marked by deep peristaltic indentations. It is that part of the stomach that Forssel has termed the sinus.

From our roentgenological observations we can state definitely that the greatest peristaltic activity is visible in the sinus. It is also worthy of mention that from the beginning of digestion (initial wave) until the stomach is entirely empty the sinus is seen filled and is the place of greatest peristaltic activity. The reservoir sac forms the largest part of the stomach only in the early stage of digestion, while later in the course of digestion most of the food is seen in the sinus. This would tend to demonstrate that the need for the reservoir diminishes in the course of digestion.

Our conception of the mechanical part of digestion, especially with reference to the mode of peristalsis, is as follows: Like Cannon we believe that the sac is the actual reservoir, and is that part of the stomach in which non-acidified food is stored until it is sent down, little by little, by the active reservoir to the tube to be acidified. From the tube, active peristaltic waves propel the acidified food to the sinus, where it meets pepsin secretion from the peptic glands in the sinus and that imported from the vestibule.

In the sinus the most active peristalsis takes place in order to churn and fully liquefy the food to be ready for the vestibule, whence the food is brought to the sphincter pylori (pyloric canal, Cannon). The reason why the cardiac sac is the largest part in the early stage of digestion is that at first only the fluids and such food as needs less digestion are transferred from the sac. An hour or two later, when secretions and acidity are at their height, the coarser food more difficult of digestion can be taken care of in the sinus; the sac transfers it with greater rapidity and the sinus serves not only as a place of active digestion, but sends it, little by little, as it is made ready, to flow into the vestibule. The activity of peristalsis in the sinus as digestion goes on is, according to our opinion, responsible for the pylorus forming the lowest part during that time of digestion, an observation first made by Cannon and von Bergman. Active contraction in the sinus shortens that part, making the pyloris appear as the lowest part.

Passage of food through the sphincter pylori is brought about by the acid reflex (Cannon) on the pyloric side opening the sphincter. Closure of the pylorus is accomplished by the acid reaching the first portion of the duodenum (Hirsch, Pawlow and Mering).

3. Gastric Secretion. Gastric secretion was first roentgenologically described by E. Schlesinger, Normally it manifests itself only as a small intermediary layer between the air-bag and the corpus when the contrast meal is given (Fig. 8). The intermediary layer is lighter than the rest of the contrast substance, and of an ashy color. This secretion layer is normally only seen in the beginning of digestion. In some cases no secretion layer is seen during any part of digestion.

Fig. 8

4. Mode of Filling and Motility. An understanding of the mode of filling of the normal stomach, as well as the time of emptying under normal conditions, is essential in order to judge it intelligently in pathological conditions. The stomach in an empty state represents a narrow sausage-shaped tube, with lesser and greater curvature separated from each other. This was conclusively proved by the ingenious experiment of Groedel, who fastened silver pearls along both curvatures of the stomach of a dog in order to make the outlines of the stomach visible to roentgen rays. At the top of this narrow tube, just under the diaphragm, air is seen (air-bag or magenblase). When food is taken the filling of the normal stomach occurs in the following manner: The first morsel reaching the fundus (fornix) stops just below the air-bag (Fig. 9*a*) for an appreciable time, three to five seconds. It then slides downward, forming a triangle with its base upward (Fig. 9*b*). Then it is seen in an elongated sausage-shaped form (Fig. 9*c*), finally reaching the caudal point (Fig. 9*d*). This entire procedure occurs along the lesser curvature in the groove of Retzius, termed "magenstrasse" (road to the stomach). The successive morsels follow the same road until about five tablespoonfuls are taken, when the stomach is seen filled in its entire form from the fundus to the pylorus. The rest of the meal, or 500 grams, distends the stomach in width but not in length.

The emptying time for the Reider meal under absolutely normal conditions has been estimated by most authorities to be between three to six hours. When food is given with barium instead of

bismuth, emptying is hastened by one hour. We use a more substantial meal consisting of 400 grams buttermilk, 80 grams barium sulphate. Two soft-boiled eggs, and 50 grams buttered white bread. After such a meal we invariably find the stomach empty in six hours in absolutely normal individuals. The bull-horn type empties sooner than the siphon type.

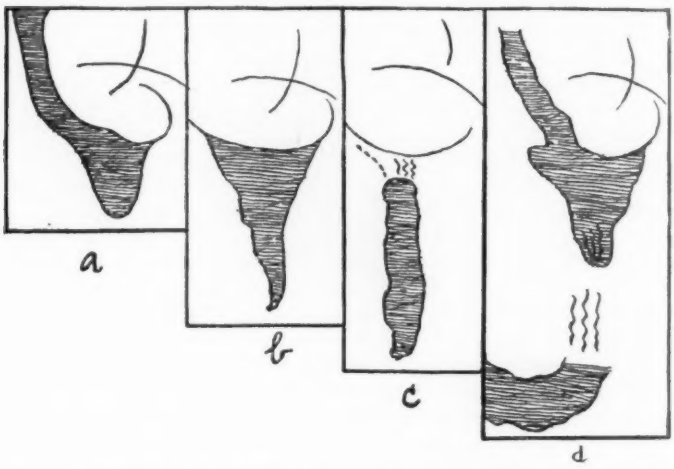

FIG. 9.—*a*, first morsel; *b*, triangle; *c*, sausage shaped; *d*, caudal part. (Groedel.)

5. MOBILITY. Normally, the entire stomach moves upward with inspiration and downward with expiration. With the palpating hand or by a Holzknecht distinctor one can displace a normal stomach in all directions. The bull-horn-shaped stomach is not as freely movable as the siphon form. Exaggerated mobility is seen in individuals with status asthenicus. A siphon-form stomach moves up to three to five inches, with the patient in the horizontal position. The bull-horn stomach moves up very little in the horizontal position, mostly from one-half to two inches.

Having briefly discussed the roentgen-ray physiology of the stomach we are more nearly ready to interpret the importance of deviation from the normal, upon which diagnosis of simple and complicated ulcer is so greatly dependent.

In the roentgen-ray diagnosis of a simple ulcer the indirect method should afford a means in the majority of cases for determining the existence of an ulcer as well as its localization. Hyperacidity and hypersecretion, being the main functional disturbances in ulcus simplex, are largely responsible for the roentgen-ray manifestations. The same functional disturbances, however, express them-

selves roentgenologically differently, depending on the underlying tone of the stomach. Hence our interpretation must be guided by the fact whether we are dealing with an ortho-, hypo-, or hypertonic stomach. Our roentgen-ray observation in ulcus simplex, independent of the tone of the stomach, must be directed to the following cardinal points:

1. Mode of filling, position, and peristalsis.
2. Sensitive pressure points.
3. Secretions.
4. Standing contraction (persisting contraction).
5. Time of emptying.

1. Mode of Filling, Position and Peristalsis. With these points in mind our roentgen-ray observations of the simple florid ulcer in an orthotonic stomach are the following: The organ fills slowly, the food staying in the fornix longer than usual. The entire stomach distends slowly as the food comes down, and peristalsis throughout the organ, from incisura cardiaca to pylorus, is almost instantaneous. The period of repose is shortened or even missing.

The peristaltic waves even in the tube are usually deep, and especially so in the sinus, so that at the beginning of the vestibule the waves deepen to such an extent that the stomach appears divided into two compartments. The peristaltic waves are of a lasting and standing nature, indicating that normal contraction waves are here converted into a state of spastic contraction. The number of peristaltic waves to each minute is diminished.

Because of such marked contractions the stomach has more of a transverse appearance, with the sinus and pylorus to the right of the median line, which also makes the pylorus appear to be the lowest part of the stomach. The vestibule (pylorus) is closed, indicating the existing spasticity; whatever food passes through the sphincter is seen in a very thin stream (goose feather); even the first portion of the duodenum is not completely filled and the small intestine fills very slowly. Later in the course of digestion one sees peristalsis less active than in the beginning, probably due to exhaustion of the musculature, but the pylorospasm still persists.

The mode of filling and peristalsis thus described is observed independent of the seat of the ulcer.

Secretion, standing contraction, and time of emptying will often indicate not only that an ulcer exists but even its location.

2. Sensitive Pressure Point. Jonas and Jolasse laid considerable stress on the diagnostic importance of sensitive pressure-point in ulcer of the stomach in determining the existence as well as the seat of ulcer. According to these authors the sensitive pressure-point is movable with the mobility of the stomach brought about by respiration, etc. In simple ulcer no importance can be attached to this phenomenon. In complicated ulcer, to be described later, the sensitive pressure-point is of greater significance.

3. Secretion. The intermediary layer of Schlesinger indicating the existence of secretions, as stated above, is normally very small in the ortho- or hypertonic stomach. A large intermediary layer in such organs indicates the existence of a hypersecretion, due, in the majority of cases, to ulcus ventriculi or ulcus duodeni. We have observed in a number of cases that the secretion layer is most marked in that part of the stomach nearest to the ulcer. If the ulcer is near the cardia the layer of secretion is most marked in the fornix. If, on the other hand, the ulcer is in the tube, pylorus or sinus the corresponding regions are seen to contain the most secretions. We see, therefore, that a close study of the part of the stomach in which the secretions are most abundant may lead us to a proper localization of the ulcer.

Fig. 10.—X-ray. Hour-glass contraction. Not persistent.

4. Standing Contraction (incisura; spastic or intermittent hour-glass contraction). Standing contraction manifests itself as an indentation on the greater curvature in the region of the tube (Fig. 10). It is due to a spastic contraction of the circular muscle fibers in the plane of the ulcer. The width of the incisura is greater the larger the ulcer. This incisura persists during the entire course of digestion and seldom relaxes on the administration of atropin, tincture of belladonna or papaverin, and it can be demonstrated during repeated examinations so long as the ulcer is in a florid state. Only deep narcosis causes relaxation of the spasm and makes the incisura disappear, hence it is not demonstrable on the operating table.

The incisura, such a valuable sign in ulcer of the lesser curvature, is at times encountered in extragastric conditions (of extrinsic nature—Carman). Hirst, of London, was the first to show that pressure over the region of a chronic appendix brings about such an indentation. Baron and Barsoni, as well as Case, produced a similar

indentation by exercising pressure over the right hypochondrium in duodenal ulcer, and Carman found the same in gall-stones.

According to our experience the findings of these authors are met with very rarely, and if present at all are found only in ortho- or hypertonic individuals, and where gastric symptoms are quite prominent. The indentation is of a very transient nature. Removal of the palpating hand makes the indentation disappear. According to Carman these indentations are of extrinsic origin because no ulcer can be demonstrated at operation. It is well known, however, that the surgical diagnosis at the operating table is founded on palpation of the ulcer. Only rarely is the surgeon tempted to open the stomach and look for the ulcer. From postmortem studies it is known that scars of healed gastric ulcers are very frequently found. Roessle, who studied the etiology of gastric ulcer in relation to extragastric affections (appendicitis, gall-stones, etc.), found signs of healed gastric ulcer in a great number of cases. He accordingly termed the ulcer of the stomach a secondary affection.

From Roessle's studies as well as from our own clinical observation we are led to believe that even the transient incisura is an expression of an erosion or superficial ulcer on the lesser curvature which cannot be demonstrated at operation and heals when the etiological factor is removed. Our conviction is strengthened by the clinical observation that hematemesis may result from an appendix or diseased gall-bladder. As we know that the theory of the embolic bleeding from the stomach (Eiselsberg) does not hold it is reasonable to conclude that an eroded vessel of the ulcerated area is the cause of the bleeding, although the ulcer is so superficial that it cannot be demonstrated at operation.

It is of practical importance, when a transient incisura is found apparently of extrinsic nature, to urge the removal of the cause in order to prevent the formation of a chronic ulcer.

Incisuræ are likewise met with in individuals of a vagotonic type who have an ortho- or hypertonic stomach. Such an incisura disappears on the administration of atropin or atropapaverin or tincture of belladonna administered according to the method of Carman—*i. e.*, 10 drops, three times a day, two or three days before the examination. Its extrinsic nature is demonstrated by the non-persistence of the incisura; here again we must remember that in the vagotonic incisura, although transient, von Bergman proved the existence of a real ulcer (spasmogenic ulcer). It is therefore safer in vagotonia when an indentation is demonstrable to give the patient the benefit of the doubt and treat for ulcer.

Pressure from without (enlarged spleen, gas or tumor of the splenic flexure, etc.) on a stomach with good tone may produce an incisura. Differentiation is accomplished by palpating the abdomen in the course of fluoroscopy, thereby detecting the extragastric origin.

Carman called attention to the spastic contraction on the greater

curvature with a carcinoma of the lesser curvature. According to his view the width of the incisura is more extensive and the lesser curvature stretched out and stiff. Le Wald, Carman, Case and others described cases in which a typical spastic hour-glass contraction was due to syphilis of the stomach.

Analogous to the indentation in the region of the tube which, as shown above, is an expression of a spastic contraction of the circular fibers are the spastic contractions taking place at the cardia and pylorus if an ulcer is situated in those respective regions. If the florid ulcer is near the cardia, cardiospasm results. The entrance of the food into the stomach is hindered and the food accumulates in the esophagus above the cardia, causing a spindle-shaped dilatation of part of the entire esophagus. Either no food at all or a very thin stream of food is seen to pass through the spastic cardia.

Although cardiospasm is a very valuable sign of ulcer near the cardia it must be remembered that a number of other conditions (vagotonia, gall-stones, uremia, etc.) may cause the same condition. Only in combination with other clinical signs and symptoms of ulcer can cardiospasm be considered in the localization of the ulcer.

In order to utilize pylorospasm in localizing an ulcer we must take into account whether the spasm is confined to the sphincter pylori or involves the entire vestibule. A spasm at the sphincter manifesting itself as an abruptly cut-off pylorus, where no food is seen to pass into the duodenum for many minutes and then only in the form of a very thin stream, signifies ulcer at pyloricum. A spasm of the vestibule (pylorus proper) manifesting itself as a spigot-like tube, points to the seat of the ulcer as being aproximal to the sphincter proper. We therefore prefer to differentiate between spasm of sphincter and spasm of pylorus proper.

A spasm of the sphincter pylori may be of a reflex nature, with an ulcer on the lesser curvature of the stomach or of extragastric origin (vagotonia, chronic appendicitis, gall-stones, gastric crises, and in most acute intra-abdominal disease).

Only in combination with other clinical data of ulcer does spasm of sphincter pylori speak for ulcer ad pyloricum. By pylorospasm we understand a spastic contraction of the entire vestibule (antrum pylori). The pylorus appears elongated and contracted (spigot form). In contradistinction to spasm of the sphincter pylori food is seen to pass continually in a width corresponding to the contracted pylorus. The first portion of the duodenum (bulbus duodeni) is never seen completely filled.

A spasm confined to the vestibule only, indicates in most cases ulcer proximal to the sphincter. Unlike spasm of the sphincter pylori, spasm of the entire vestibule is but seldom of extragastric nature.

Sometimes the spasm may involve larger areas of the stomach sinus and pylorus in cases of ulcer of the stomach. We then have

the picture of a tube-like sinus and pylorus and a large sac-like tube and fornix. Such a stomach simulates strongly a carcinoma of the sinus and pylorus. The differentiating points are that the pyloric sphincter in carcinoma is open, the defect is irregular, and in most cases corresponds to a palpable tumor. Very seldom does one meet with a spastic contraction of the entire stomach (gastrospasm) in cases of ulcus ventriculi. The entire organ then looks like a tube simulating scirrhous carcinoma of the entire stomach. Such a stomach empties quickly. It must be mentioned, however, that spasm of sinus pylorus or gastrospasm is most frequently of extragastric origin (morphin, nicotin or lead-poisoning, gastric crisis, cholelithiasis).

Huerter, through whose kindness we are enabled to publish Fig. 11, was the first to show that a small local spasm may be met with just as the seat of the ulcer.

In certain cases the spastic contraction of the pylorus manifests itself in irregularities with teeth-like indentations in the pylorus; the above-named changes in the pylorus are not due to adhesions but are the result of spastic contractions.

FIG. 11

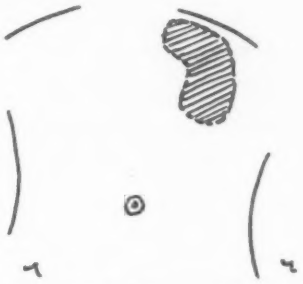

FIG. 12.—Kidney-shaped stomach.

To the localization of ulcer Schmieden contributed considerably when he described the snail or tobacco-pouch stomach. This stomach, as shown in Fig. 12, is usually situated high in the abdominal cavity, the pylorus and cardia so near to each other that but little is seen of the lesser curvature. The stomach is almost entirely to the left of the median line, and is smaller than the average stomach. Schmieden attributes this configuration to the excessive contraction of the longitudinal musculature, the result of an ulcer of the lesser curvature. The findings of Schmieden were confirmed by other observers.

His belief that the tobacco-pouch stomach is characteristic only of ulcer at the lesser curvature, and is the result of an ulcer penetrating directly into longitudinal muscle, does not correspond to our experience. We found that this form, even with ulcer of the

lesser curvature, is only present at the time when the subjective disturbances due to ulcer are pronounced, proving the functional nature of the deformity. Besides that such a snail-form stomach may be the result of extragastric influences.

If pressure from without—such as gas or tumor in the splenic flexure, tumor of the pancreas—is exerted on the stomach musculature of normal tone an organ of the tobacco-pouch shape may result.

We see therefore that useful as is this form of stomach in diagnosis and localization of gastric ulcer it will lead to mistake if we base our diagnosis on the roentgen-ray findings alone.

5. Time of Emptying. The time of emptying after a standard meal as mentioned above, when barium sulphate is used as a contrast substance, is from two and a half to four hours, and when bismuth subcarbonate is given, from four to five hours. Six hours is the maximum time of emptying.

Some authorities have objected to accepting the roentgen rays as a determining method for the emptying time, asserting that the contrast substance may hasten the emptying in some cases and retard it in others independent of disease. Bassler even obtained contents with the stomach tube in individuals in whom no roentgen-ray residue was visible. We concede the above possibilities, with the exception that under perfectly normal conditions the vast number of cases already studied by roentgen rays throughout the world demonstrate that a normal organ empties itself of a standard meal within six hours and residues demand an explanation.

Haudek and Clairmont laid down a definite rule that when a florid ulcer of the stomach is present there is in every case a six hours' residue. Roentgenologists of large clinics, notably Faulhaber, von Bergman, Case, Carman, Hirsch and others contradict the assertions of Haudek. Faulhaber formulated the rule that a six hours' residue is only present when a florid ulcer is situated at the pylorus; if, on the other hand, the ulcer is situated proximally to the pylorus there is no six hours' residue.

That the assertion of Haudek cannot be taken as absolute is proved by the fact that clinicians like Riegel, Boas, Ewald, Strauss, L. Bamberger and others who studied extensively the influence of ulcus ventriculi on time of emptying would have found by their exact methods a delay in emptying pathognomonic of ulcus ventriculi. In reality, however, this was not the case.

The findings of Haudek must therefore be attributed to three factors: (1) that most of the cases studied by him were complicated surgical ulcers; (2) Haudek allowed food between the six-hour periods; (3) he does not specify the existing tone of the stomach where residues were found. Faulhaber's assertions are far more applicable in the greater number of cases, but they are dogmatic and lack explanation.

From experiences obtained thus far we agree with von Bergman that a six hours' residue is most often present when a florid ulcer is situated at the pylorus, and in a lesser number of cases a residue is present even in an ulcer situated proximally from the pylorus, although the organ is of good tone.

Continental roentgen-ray men made the correct observation that location of the residue often indicated the seat of the ulcer. When the ulcer is at the pylorus the residue is more in the pyloric region, while an ulcer in the region of the tube shows the residue in that location. It is also worthy of mention that florid pyloric (sinus) ulcers give large residues which sometimes extend to twelve hours. Such residues often simulate organic stenosis, and only atropin or atropapaverin or the subsidence of the florid state show that the residue was due to a prolonged spasm of the sphincter pylori.

With an ulcer on the lesser curvature in the region of the tube, if residues are present at all they are usually small. In a pyloric ulcer the residue is easily explained by the spasm of the sphincter pylori brought on by the continuous hypersecretion. When the ulcer is in the region of the tube the reflex spasm is only present during the first hours of digestion, as long as considerable quantities of food are still transported from tube to sinus. After that the cause of irritation is removed, both local spasm (standing contraction) and reflex pylorospasm are removed and the stomach empties itself on time. In a smaller number of cases the local ulcer causes enough hypersecretion to bring about a more persistent local spasm. Here we find a small residue situated to the left of the median line which consists chiefly of secretions and contrast substance. Clinically, such patients have pains from one-half to one hour after meals, lasting until regurgitation or vomiting of the excessive secretions brings relief. The six hours' residue is of substantial diagnostic importance in pyloric ulcer.

As a matter of fact, however, six hours' residues are at times found in the stomach not the seat of an ulcer. This should not discredit its diagnostic importance if the distribution of the contrast substance throughout the intestines is taken into consideration in connection with the residue in the stomach.

In simple ulcer of the stomach the small intestines show six hours after the meal, but very little contrast substance. This is due to the fact that the excessive secretion and peristalsis of the stomach brings about thorough chymification and digestion, so that the digestion in, as well as the motility of the small intestine is hastened.

If in six hours after a meal a residue is found in the stomach accompanied by an overfilling of the small intestines with contrast substance it is usually of extragastric origin.

The most frequent causes are atony of the stomach of extra-

gastric origin (status asthenicus, wasting diseases, old age, etc.) and achylia gastrica without hypermotility of the intestines. In both cases the deficient digestion of the food in the stomach necessitates a prolonged stay of the food in the small intestines for vicarious digestion, thereby retarding the emptying of the stomach.

A small residue in the stomach characteristic of duodenal ulcer, or gall-stones with duodenal irritations, or adhesions around the duodenum is, according to our opinion, which we have repeatedly demonstrated by the stomach tube, due to the gastric secretions holding the contrast substance in suspension, and it in reality therefore only simulates a residue.

Ulcus Simplex in a Hypotonic Stomach. The roentgen-ray manifestations brought about by the hypersecretion and hyperacidity resulting from the ulcer are somewhat different in the hypotonic stomach than the hypertonic stomach. In diagnosis of ulcus ventriculi in the hypotonic stomach it is also best to direct our attention to the following cardinal points: mode of filling, position of the stomach, peristalsis, sensitive pressure-point, secretions, standing contraction, and time of emptying.

The mode of filling in the hypotonic stomach without an ulcer is as follows: the food is seen to drop down to the caudal piont, the stomach filling itself from below upward. Most of the food is seen in the sinus and pylorus; while the tube contains but little food, the fornix (sac) is made up of a large pear-shaped air-bag.

The position of the hypotonic stomach when the seat of a florid ulcer differs from the non-diseased hypotonic stomach, inasmuch as the sinus and pylorus are considerably to the right of the median line (for comparison see Figs. 13 and 14), so that the pylorus is lower than the normal hypotonic stomach and early in the filling process, before peristalsis sets in, the sinus and pylorus give the impression of a half-moon or boat-shaped organ.

Peristalsis begins earlier than in the normal hypotonic stomach. Whatever is visualized of the tube shows but very superficial peristalsis, while in the sinus and pylorus peristalsis is so deep that the stomach is seen separated into two or three globe-shaped compartments. Because of the excessive contractions the stomach appears shorter. The intensity and duration of the peristaltic waves due to the underlying weakened tone of the musculature is only transient. Secretions are usually very marked; they are seen to fill the tube and even sinus and pylorus. Sensitive pressure-points have very little value in simple ulcer in general, especially so in hypersensitive individuals.

The standing contraction discussed above, which is of such value in the localization of ulcer in the ortho- or hypertonic stomach, cannot be utilized to such an extent in the hypotonic individual. This is primarily due to the weakened musculature of the tube. In a number of cases, even in a hypotonic stomach, the standing

contraction can be brought about when the patient is examined in a horizontal position. The standing contraction is only to be utilized as pathognomonic of ulcer of the lesser curvature in case it persists when the patient is examined on his back, abdomen, or on his right side. This will help us to rule out a standing contraction brought about by pressure from without.

FIG. 13.—Hypotony.

FIG. 14

While the standing wave is of but little value in the hypotonic stomach the spastic contractions at either end of the stomach (cardia or vestibule) are of great aid in the diagnosis and localization of ulcer. If the ulcer is at the cardia the associated cardiospasm with the characteristics described above are met with. In the hypotonic stomach the interpretation as to whether the cardiospasm is the result of traction on the esophagus or because of an ulcer will depend on the knowledge of the entire clinical picture.

If the ulcer is at the pylorus, spasm of the sphincter pylori results.

Time of emptying in the hypotonic stomach is moderately delayed even in a normal individual, but after six hours the hypotonic stomach, not the seat of ulcer, is empty. If an ulcer is present the six hours' residue is only present when the ulcer is in the vicinity of the sinus or pylorus, demonstrating again that the residue is the result of the existing spasm of the sphincter. It was pointed out by Kreutzfuchs that a hypotonic stomach with pyloric ulcer shows smaller residues than a hypertonic stomach. The same author attributed this to the fact that spasm of the sphincter pylori in the hypotonic stomach is not so persistent and lasting as in the hypertonic stomach.

DIFFERENTIAL DIAGNOSIS. We have attempted to show that by means of the indirect method one can, depending on the functional disturbances caused by the ulcer, obtain definite roentgen-ray data as to the existence and seat of a simple ulcer. We have also shown that the roentgen-ray manifestations in individuals with ortho- or hypertonic stomachs are different from those in individuals with a hypotonic organ, because the functional disturbances caused by the ulcer are not alike in both types. It is clinically known that a great many chronic intra-abdominal diseases of extragastric origin, as well as functional and organic nervous diseases, cause gastric symptoms simulating ulcer. As these symptoms are dependent on disturbed gastric function (hyperacidity, hypersecretion, etc.) it might be supposed that the roentgen-ray findings of the stomach would, to a great extent, likewise simulate ulcer. While such a supposition is in a certain number of cases correct, and a differential diagnosis impossible; it will be shown that in a great number of cases the roentgen-ray findings furnish an important additional link in the establishment of an exact diagnosis.

It is self-evident that intra-abdominal diseases, like appendicitis, gall-stones, renal colic, etc., which by virtue of the local affection cause corresponding local symptoms, give no rise to diagnostic difficulties and make the roentgen-ray examination of the gastro-intestinal tract superfluous. We refer to intra-abdominal diseases of extragastric nature in which the local symptoms are insignificant as compared to the reflex gastric symptoms. Such diseases may manifest themselves in the form of either acute or chronic gastric disturbances.

In the state of acute exacerbation, be the cause appendicitis, gall-stones, and tabes dorsalis, or vagotonia, it is, as pointed out by Mayo, the persistent pylorospasm that is responsible for the acute attack. The roentgen-ray manifestations will therefore be those of pyloric ulcer with marked gastric retention.

At operation the real cause of the mere functional nature of the spasm will be found. A number of careful observers, like Levy and Kantor, Levy-Dorn, von Bergman and others, described their experiences of cases which roentgenologically showed marked retention in the stomach and the operation revealed gall-stones, chronic appendicitis, etc. Levy, of Syracuse, is right when he asserts that the mistake is not a serious one so long as a surgical condition is the cause of the symptoms.

It must, however, be mentioned that vagotonia, gastric crises, abdominal vascular crises causing during acute attacks pylorospasm, and gastric retention must be thought of and excluded.

These extragastric diseases after subsidence of the acute symptoms may leave the patient with chronic gastric complaints, such as pyrosis, epigastric pressure, fulness after meals, marked sensitiveness to various articles of food, etc. The gastric symptoms are of

reflex origin and are due to hyperirritability of the stomach. In this state even a normal stimulus causes abnormal sensations. Such an individual therefore is found with secretions quantitatively and chemically normal but with symptoms of hypersecretion and hyperacidity. Should secretions be actually increased the symptoms are aggravated out of proportion. Some cases, although showing a subacidity, will, on account of local hyperirritability, have symptoms of hyperacidity (anacida hyperacida, Strauss).

It is well known to all clinicians how difficult it is to diagnose such cases with exactness. Only too often has the stomach erroneously been accused of being the seat of the disease and quite as frequently a gastric neurosis or other intra-abdominal disease diagnosed when the stomach is the seat of the affection.

Roentgen-ray studies of the gastro-intestinal tract by means of the indirect method have proved a very valuable aid in differential diagnosis. Such functional disturbances as can be visualized by the roentgen rays (hypersecretion, hyperperistalsis, etc.) do not differ from a functional disturbance of the stomach due to ulcer. The vital difference lies in the fact that if an ulcer gives rise to functional disturbances, material interference with the chemical and mechanical action of the stomach results as described above, while in reflex gastric disturbances the functional derangements manifest themselves only in the beginning of digestion, becoming adjusted as digestion continues. On account of such an adjustment there is no delay in the emptying of the stomach. This fact and other points to be mentioned enable us in a fair percentage of cases to localize the seat of the disease.

For roentgen-ray differentiation of ulcus ventriculi from chronic appendicitis simulating ulcus ventriculi the following points are useful:

Individuals with orthotonic stomachs will show characteristics of hypertonicity due to reflex disturbance of the vagus from the chronic appendicitis. This will at first sight give the stomach the roentgen-ray appearance of an ulcer of the stomach. Prolonged fluoroscopy, however, will demonstrate the hyperperistalsis, the spasm of the sphincter pylori, the transversely situated stomach to be only of transient nature. Passage of the food through the pylorus is normal. The observation of Hirst that pressure over the appendix produces an incisura on the greater curvature near the cardia simulating ulcer of the lesser curvature is indeed at times met with, especially in congenital vagotoniacs. This incisura, however, is extraordinarily fleeting. After removal of the hand from the region of the appendix the indentation soon disappears.

Very conclusive is the observation six hours after the contrast meal. The stomach is usually entirely empty, but the small intestine, and especially the ileum, are unusually full. If in addition to this one finds fluoroscopically a fixed cecum the diagnosis of chronic appendicitis is strengthened.

In individuals of the asthenic type, where chronic appendicitis simulates ulcus ventriculi one finds, when the stomach is full, the characteristics of the hypotonic stomach. The most important finding is delay in the ileum. In cases in which vagotonia is a marked factor, even the hypotonic stomach may show hypercontractions of sinus pylorus as in ulcer, but unlike ulcer the hypercontractions are of a very transient nature.

Cholelithiasis with gastric symptoms simulates more often clinically and roentgenologically ulcus duodeni, and therefore is not discussed here.

Individuals of the vagotonic type will clinically and roentgenologically simulate ulcus ventriculi. A differential diagnosis can only be made by repeated examination, demonstrating the instability of findings in spite of existing symptoms. It cannot be emphasized too strongly that vagotoniacs, as first pointed out by von Bergman, are very often predisposed to ulcus ventriculi.

Individuals with disturbed intermediary metabolism, such as phosphaturia, oxaluria are very frequently subject to gastric symptoms simulating ulcer. Such patients are subject to a long list of general nervous symptoms, including gastric hyperacidity, especially in phosphaturia, and should their attention be diverted by the physician to the hyperacidity, the suggestion that the disease is primarily gastric never leaves them.

The diagnosis rests with complete examination of the urine and the favorable results obtained by properly applied therapeutics. The roentgen ray is of aid inasmuch as negative findings are obtained.

Complicated Ulcer. If simple ulcers do not progress favorably they may lead either to the ulcer penetrating all the layers of the stomach including serosa as well as adjacent organs, or to excessive connective tissue formation, adhesions, etc. We then speak of complicated ulcer. Here the roentgen ray directly visualizes the existence as well as the seat of the ulcer in the great number of cases.

Ulcus Callosum. In long-standing ulcers, as a result of round-cell infiltration and connective-tissue formation at the seat of the ulcer, a callous ulcer results. Roentgenologically this is best demonstrated when situated, as it often is, on the lesser curvature. It is seen as a diverticulum filled with contrast substance (Fig. 15), mostly round, sometimes quadrangular or triangular. Haudek named this diverticulum "niche." When the stomach is quite emptied the diverticulum is likewise empty. Such diverticuli are but seldom situated on the posterior or anterior walls of the stomach. For the visualization of a niche on the posterior or anterior wall, special methods of examination have been suggested. Holzknecht advises that the patient take a contrast suspension while lying on the right side and remain in that position for a few minutes; he should then take the Rieder meal in the sitting position, be fluoroscoped, and a plate taken in the standing position. To render a

diverticulum visible on the posterior wall, Schwartz advises that the patient take the bismuth suspension while on his back and remain in that position for a few minutes, then sit up and take the Rieder meal, then be fluoroscoped and a plate taken in the ventrodorsal position (front to tube and back to screen). For a niche on the anterior wall it is best to fluoroscope and take a plate with the patient lying face downward.

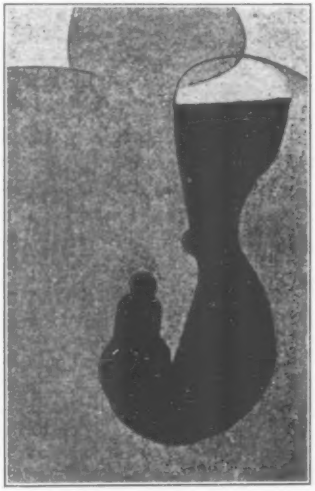

FIG. 15.—Ulcus callosum of small curvature.

Two conditions which may simulate the picture of niche are: the presence of contrast substance in a loop of small intestine which happens to overlay the lesser curvature, and calcareous glands in the region of the lesser curvature. Cole recently expressed the view that such a diverticulum signifies in the majority of cases carcinomatous degeneration of the ulcer. This was emphatically contradicted by I. S. Hirsch. From our own experience we agree with Hirsch, Haudek and others that a niche does not signify malignant degeneration.

Cole in this connection creates a new term—"indurative" ulcer. He defines an ulcer as indurative when surrounded by an amount of exudate reaching the muscular coat, so that the ulcer can be palpated during surgical procedure or necropsy. By his direct method of visualization by serial radiography, he diagnoses the existence of such an ulcer by the absence of peristalsis in that particular part so that the area appears to be stretched out. The indurated ulcer he considers as a stage preceding the callous ulcer.

He therefore strongly emphasizes the importance of recognizing an indurated ulcer so as to prevent the occurrence of a callous ulcer, which he considers analogous to a carcinomatous degeneration of the ulcer.

In the same article Cole publishes cases not at all corresponding to his definition. For instance, in the case operated by Deaver the ulcer could neither be seen nor palpated until the stomach was opened, and still when Cole examined that case before operation he claims to have found roentgen-ray evidence of threatening perforation. Another of his cases, in which he shows the straight line on the lesser curvature corresponding to the indurated area, proved at the operation to be due to adhesions. A number of his other photographs show ordinary niches.

Our conclusions cannot be modified by his article, and we believe that a stretched-out or stiff lesser curvature is the result of adhesions, or as Levy-Dorn has pointed out, small carcinoma on the lesser curvature. Real marked indurations manifest themselves as niches (Haudek).

FIG. 16.—Penetrating ulcer.

ULCUS PENETRANS. We speak of penetrating ulcer when repeated small perforations have taken place, resulting in adhesions between the ulcer and the neighboring organs. These adhesions are mostly found between the stomach and the liver or pancreas. The penetrating ulcer manifests itself as a niche filled with contrast substance on top of which a small air-bag is seen (Fig. 16). This niche and air-bag are seen after the stomach has emptied itself.

Penetrating ulcers on the posterior wall of the stomach are localized by examining the patient in a ventrodorsal position. From the description it is evident that we must not confuse callous ulcer with penetrating ulcer. From our studies we have reason to believe that the callous ulcer, especially of the lesser curvature, is mostly present in an ortho- or hypertonic stomach, while a penetrating ulcer of the lesser curvature is found in the hypotonic stomach. With a callous ulcer on the lesser curvature there is often a small standing contraction opposite the seat of the ulcer, while in

a penetrating ulcer the region of the stomach corresponding to the seat of penetration is only seen in the form of a small streak of contrast substance with accumulation of contrast in the cardia above and the sinus-pylorus below. Such a stomach simulates an organic hour-glass contraction.

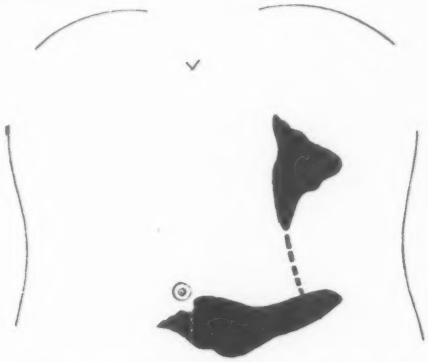

FIG. 17.—Hour-glass contraction of the stomach.

ORGANIC HOUR-GLASS STOMACH DUE TO ULCER. This stomach results when excessive connective-tissue formation divides the stomach into two compartments. The roentgen-ray manifestations of such a stomach (Figs. 17 and 18) are the following:

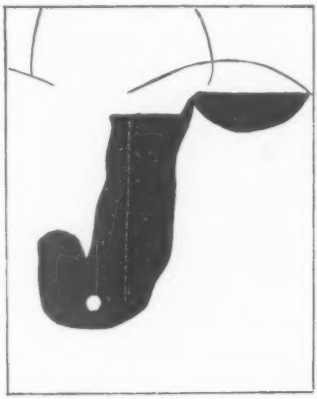

FIG. 18.—Rare form of hour-glass stomach. (From Faulhaber: Roentgendiagnostic d. Nagenkrankheiten.)

When the contrast food is taken only the cardia fills, forming a round ball lying directly under the diaphragm. From time to time

only a string of contrast substance is seen to dribble down to the lower compartment forming two distinct portions.

There are a few other affections of the stomach which may simulate hour-glass contraction—carcinoma of the greater curvature in the region of the tube at times gives such a complete defect that the stomach looks subdivided into two compartments connected by a narrow band. In carcinoma, however, the intervening space between the two sacs has an eaten-out appearance corresponding to a distinct defect in filling. The connecting link between the two sacs is wider and corresponds to the lesser curvature. Fluoroscopically one sees such a stomach fill in both sacs simultaneously because of the food dropping down through the involved part very readily. Palpation in the course of fluoroscopy will disclose a palpable mass corresponding to the region of the defect.

Syphilitic gumma of the stomach, as pointed out by Le Wald, may simulate an hour-glass stomach but the intermediary zone likewise shows irregularity and has more the characteristics of carcinomatous hour-glass contraction. Syphilitic gumma of the stomach is rare and the serological examination as well as the therapeutic test will clear up the diagnosis.

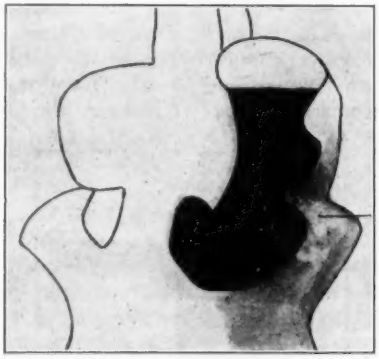

FIG. 19.—Gas in splenic flexure simulating hour-glass contraction.

Tumors of neighboring organs or enlarged spleen as well as gas in the splenic flexure may exercise pressure on the tube of the stomach, causing such an active contraction of the greater curvature (Fig. 19) as to simulate hour-glass contraction. In such an organ the filling is almost normal, but when the stomach is entirely full the narrowing of the tube becomes more distinct, due to the strong contraction of that part. Such a stomach appears shorter and sinus-pylorus to the right of the median line.

COMPLICATED ULCER IN THE REGION OF THE VESTIBULE. A callous ulcer in the region of the pylorus results in stenosis of

various degrees, depending upon whether the pylorus is incompletely or completely occluded. With incomplete obstruction one sees the elongated pylorus without any activity. Even the entrance into the vestibule shows no marked indentation. Peristalsis in the sinus and high up in the tube is increased; whatever food passes the pylorus is seen in a very thin stream. The six-hour residue is very large, due both to the organic stenosis and associated spasm of the sphincter. Residues may extend to twelve and even twenty-four hours. If obstruction is complete the characteristic half-moon-shaped or boat-shaped organ results. Such a stomach never empties in contradistinction to a similarly shaped hypo- or atonic stomach that is sometimes encountered with an ulcer of the pylorus (Fig. 19).

FIG. 20.—Light zone decribed by Brügel due to callous ulcer in the lower part of pylorus.

A deep-seated ulcer, or adhesions at the pars pylorica, is characterized, according to Brügel, by a horizontal, light, prepyloric zone between the contrast meal above and the pyloric part below. It is requisite that repeated examination shall confirm this finding. Not infrequently pyloric ulcer is complicated by extensive peripyloric adhesions, which manifest themselves roentgenologically by irregularities of the pylorus, stretching of the pylorus to the right of the median line, inability of the pylorus to act with respiratory movements. With marked adhesion the sensitive pressure-point corresponding to the area of adhesions is often very marked. Extensive adhesions posteriorly give the stomach the appearance described by the anatomists, *i. e.*, a transversely high situated stomach with restricted mobility and very superficial peristalsis.

WAR MEDICINE

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VINCENT'S ANGINA INFECTION: ITS PREVALENCE, VARIED MANIFESTATIONS, TREATMENT, AND BACTERIOLOGY.

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THE reported frequency of Vincent's angina among the Allied troops serving in France makes a consideration of this malady, and a note or two concerning its bacteriology and treatment, of interest to all concerned with the health of our own men, of whom so many will soon be serving under like conditions. Taylor and McKinstry[1] reported that "during the last few months" over 300 cases of the malady had been confirmed bacteriologically in the Queen Alexandra Military Hospital

[1] British Med. Jour., March 31, 1917, p. 421.

and that "constant presence of these organisms" (the fusiform bacillus and spirillum) had been "abundantly verified" in all forms of ulcero-membranous inflammation of the mouth, either alone or associated with various forms of cocci, bacilli and leptothrices.[2]

The last-named observers report that cases of the disease, when affecting the gum margins, were often confused with pyorrhea alveolaris, although pus is usually not produced.

Bouty[3] states: "During the last two years there has been a gradual and marked increase in the number of cases of Vincent's angina among the troops in France, both British and French. In time of peace this disease forms about 2 or 3 per cent. of all cases of throat complaints among the French army (recent statistics). Recent statistics from a British military hospital in France show the proportion to be as high as 23 per cent. of all throat complaints."

Campbell and Dyas[4] reported that during the four months from October, 1916, to February, 1917, 129 cases of the disease had been treated in the Canadian military hospital at Bramshott, England.

Prevalence in the United States. I know of no statistics that would show the extent of the prevalence of the disease in this country. It has not been made reportable by any health department, and, short of this or a bacteriological examination of a large number of diseased mouths, throats, etc., in various localities, nothing exact could be known.

The literature dealing with the malady is not great, but there are sufficient reports to indicate that the malady is of universal distribution, although severe cases are not very common under normal conditions in civil practice. However, from the British experience aforementioned, we may anticipate a greatly increased incidence under military conditions.

Among civilians during the last few months I have noticed an apparent increase in the number of tonsillar and pharyngeal smears, met with both in hospital and private practice, even over the usually increased winter incidence, that show the fusiform spirilliform organisms identified with the condition. Here it may be mentioned that, under the procedures in use at present, in order to make a laboratory diagnosis of the condition a smear and not only a culture is required, the latter alone being sometimes sent for diagnosis.

Predisposing Causes. While general debilitating conditions, such as extreme fatigue, chilling, insufficient or improper food, excessive alcohol consumption or the presence of other debilitating disease, undoubtedly markedly influence the incidence of the infection of Vincent's angina, locally acting influences are known to be often determining. Among these are decayed, broken or dirty teeth and excessive smoking or chewing of tobacco.

Exciting Cause. This is undoubtedly the organism so constantly associated with the lesions, and which will be considered in detail under Bacteriology.

Location and Appearance of Lesions. The typical lesion consists of a heavy, dirty-looking membrane commonly covering one of the tonsils,

[2] Emrys-Roberts, British Med. Jour., September 15, 1917.
[3] British Med. Jour., November 24, 1917.
[4] Jour. Am. Med. Assn., June 2, 1917, p. 1596.

although it may be located any place upon the nasopharyngeal or buccal mucous membrane. It may even extend as a single membrane over most of the surface of the upper respiratory tract, as it did in one of the cases reported in this article. When the membrane is upon the tonsil it commonly either shows a crater-like excavated center or is so necrotic that slight pressure, as with the end of a platinum loop, breaks through and the probe sinks in a half-inch or more. The ulcerations of the disease often cause considerable destruction of tissue and consequent scarring.

Apart from the typical lesions, as described, we must recognize pathological processes of less severity, and which are consequently, less apt to be noticed. Such usually consist of moderate tonsillitis or gingivitis, which has a tendency to chronicity, with now and again a severe attack with lesions of the type first described. An interesting case of this character is detailed in what follows.

In view of the synchronous purpuric manifestations so intimately connected with the throat lesions in the last-mentioned case (see after), and as acute pharyngitis precedes so many cases of purpura, it may be that the specific agent of Vincent's angina has much responsibility for the latter.

Mulholland reported 16 cases of ear infection with Vincent's angina organisms.[5]

Spillman reported a case of gangrene of the vulva and perineum caused by this infection, and Noguchi reported a case of ulcer of the labia due to the same.

Vincent reported several cases of gastro-enteritis in which post-mortem examination showed large numbers of the typical organisms in the intestines.

Ulcerative balanitis due to this organism was described by Corbus and Harris as the "fourth venereal disease." In reporting several cases they declared their belief that this infection was often mistaken for chancroid. The ulcers of the two conditions may resemble each other closely. In chancroids, however, the presence of the causative agent—the Ducrey-Unna bacillus—and the much greater reaction in the buboes, which often suppurate, serve to differentiate.

Bowman[6] reported the case of a soldier with extensive ulceration in the mouth, a severe conjunctivitis and an ulcer on the penis (surrounding the meatus), in all of which lesions the typical organisms were found (Wassermann test negative). Four other cases with penile ulcers due to the same cause were reported by Campbell and Dyas (above).

The latter authorities also reported 7 cases in which a moderately severe bronchitis, with sputum loaded with the typical organisms, was the only lesion.

The writer examined the sputum of a patient (A. H.) suffering from chronic bronchitis in which Vincent's angina organisms were so typical and numerous that he supposed the patient to be suffering from a throat infection, but, upon inquiry, was assured by the attending physician (Dr. O. M. Leiser, New York City) that the lesion was entirely bronchial and pulmonary.

[5] Annals of Otol., Rhin. and Laryn., September, 1915.
[6] Lancet, October 6, 1917.

This case was of six months' duration and manifested chronic cough, physical signs of bronchopulmonary catarrh and progressive emaciation; lost thirty pounds. The patient was sent to a tuberculosis sanatorium and, in two months, regained the loss and returned apparently recovered (no tubercle bacilli were ever found in the patient's sputum).

Another case met with by the writer recently was one of nearly daily raising of a small quantity of bronchial mucus on the part of a patient with slight chronic gingivitis. At the time of sputum examination the patient presented a slight ulceration along the inner edge of the under lip. Bronchial mucus, gum margins and lip lesion all showed the typical organisms.

Bouty (see before) reported a recurrence of Vincent's angina on the other tonsil, which was followed in three days by acute nephritis.

In articles on noma, Brault,[7] Herrman[8] and Rona[9] elucidated evidence proving that this malady was caused by the same organism as Vincent's angina and that the difference in the lesions was but one of degree. Vincent[10] considered hospital gangrene a form of the same infection.

Symptoms and Constitutional Effects (Throat Cases). These, while directly proportional to the severity of the process, are much less than would be expected from the appearance of the lesions.

Besides the appearances of the involved areas there usually is slight sore throat, headache, malaise, swelling of glands adjoining the ulcerations (in severe cases adenitis is often marked and painful) and a slight elevation of temperature. In severe cases the breath is always fetid. A membrane is usually not formed until the general symptoms have lasted a day or two.

More extensive general manifestations may, however, occur in some cases, as in one detailed herewith, in which nosebleed, gum hemorrhages and general purpuric manifestations seemed to be directly due to the infection. Severe cases reported from the European military hospitals have manifested great prostration, high fever and albuminuria. Recrudescences, as for instance a week or ten days after apparent recovery from an ulcerative process on one tonsil when an ulceration develops upon the soft palate or the other tonsil, have not infrequently occurred.

Several cases (in civilian practice) are recorded in the literature as having terminated fatally. Bouty (above) states that "some cases of death have occurred in French hospitals in which the primary cause was Vincent's angina."

Two Interesting Cases. *Case with Extensive Membrane Formation.* C. H., aged twenty-seven years, a lawyer, under the care of Dr. Stephen De Coste, of Brooklyn, after a motor trip to Philadelphia (where he enlisted in the navy), developed a typical membrane covering both tonsils and soft palate, the entire pharynx from the glottis to the posterior nares and extending into both nostrils. The patient said he had suffered from "canker sores" in the mouth for years. The constitutional symptoms were but moderately severe.

On the second day of illness the diagnosis was made bacteriologically and a vaccine of the bacilli prepared. Treatment with the latter was

[7] Bull. Derm. et Syph., 1908, ii.
[8] Arch. Pediat., November, 1905.
[9] Arch. Dermat. u. Syph., 1905, lxxiv, 171.
[10] Deutsch. med. Wchnschr., 1894, xlix, 922.

begun by Dr. De Coste on the fourth day and two doses were given. Before its use, local applications of silver nitrate (10 per cent.) were made, and the case had begun to improve when the specific vaccine was begun. The vaccine was a suspension of 1,000,000,000 bacilli to 1 c.c. The very large first dose of 5 c.c. was followed by a marked local and slight constitutional reaction. Three days later a second dose of 10 c.c. was administered, with like manifestations. The patient rapidly improved, and was well by the tenth day.

Chronic and Fatal Case. E. L., aged forty-three years, a physician. Eight years ago E. L. had a chronic ulcer of his nasal septum operated upon, and three days later, besides having had continuous nosebleed in the interval, experienced an attack of general purpura with severe urinary hemorrhage lasting four days (no kidney involvement). Besides also bleeding from the gums and intestinal mucosa the patient's mouth and skin were covered with a small purpuric rash that persisted for several weeks. Since this attack the patient had numerous nosebleeds, gum hemorrhages and purpuric skin eruptions, commonly associated with a tonsillitis which showed as a typical Vincent's angina.

In this connection attention is called to a case (reported by Campbell and Dyas in an article aforementioned), with extensive membrane over the tonsils, entire mouth and lips, which developed an extensive rash four days after admission to the hospital. "The spots, about a dozen on each forearm and leg, were about one-quarter inch in diameter, sharply raised, copper colored, and the center of each contained a small oblong vesicle" (Wassermann negative).

About two months ago the patient (E. L.) suffered an attack which developed a heavy membranous ulceration upon his left tonsil and a general purpuric skin rash. The membrane lasted for about ten days and the rash gradually faded. Smears from the tonsillar membrane showed the typical organism.

As it seemed that the patient suffered from a chronic or recurrent localized infection, I suggested that a vaccine be employed. This was made to contain 1,000,000,000 bacilli to 1 c.c., and a dose of 0.2 c.c. was given ten days after the acute attack described. Within twenty-four hours a rather marked local reaction developed, also a slight bleeding of the gums and nose. At the end of three days the dose was doubled and was followed by a greater local reaction, gum- and nose-bleeding and some purpuric eruptions over the body. Owing to these undesirable consequences, use of the vaccine was suspended, with the intention to resume its use more cautiously as soon as purpuric manifestations subsided.

For a month after the use of the vaccine had been discontinued the patient enjoyed his usual fair health without, however, getting rid of his constant slight chronic gingivitis and nasopharyngeal involvement. At the end of this time he again developed an acute attack, with nasopharyngeal and several small buccal ulcerations. Bleeding was quite marked from the bowels and nose. Temperature was but slightly elevated and the pulse was but a little disturbed. The patient had a moderate bronchitis, with considerable expectoration.

After an illness of four days Dr. Raymond Clark (Brooklyn) was called to attend the patient and requested laboratory tests, which gave results as follows:

Blood. Coagulation time (drop method) complete, five minutes; erythrocytes: 3,144,000; size, shape and staining were normal; hemoglobin, 60 per cent.; plaques, 90,000 per cm.; leukocytes, 8800 (neutrophiles, 70 per cent.; eosinophiles, 1 per cent.; large lymphocytes, 11 per cent.; small lymphocytes, 12 per cent.; large mononuclears, 6 per cent.); culture, negative.

Feces. For ova, negative.

Sputum. Many typical Vincent's bacilli and spirilla, few or no other organisms.

Urine. Negative.

Smears. From accessible ulcerations and tonsils showed Vincent's organism to a practical exclusion of others.

At this time the bleeding from the bowels and nose had ceased, but the patient complained of severe frontal headache. For the next three days his condition remained about the same, treatment being directed to relieving his headache. Dr. Clark gave him aspirin for this, and then, when it proved insufficient, codein. At the end of the three days mentioned the patient's head pains had shifted to the left side of the head and neck and extended into the shoulder. They were evidently very severe. On the fourth day of Dr. Clark's attendance (eighth of the attack) the patient rapidly became weaker and died from what Dr. Clark diagnosed as "petechial brain hemorrhage, followed by brain edema."

From the evidence given above it seems reasonable to conclude that Dr. L. died from Vincent's angina infection.

TREATMENT. *Preventive.* It has been reported (Campbell and Dyas above) that 50 per cent. of smears made from the throats of all the troops in a military hospital showed the presence of the organisms of Vincent, so it is evident that the infection must be well-nigh universal. However, before a definite lesion can develop, certain predisposing causes must act. These it is believed have principally, if not entirely, to do with the condition of the teeth and the care given them. The predisposing influences of the irritating effects of tobacco have been mentioned.

Thus it is necessary to have the teeth of all, especially of those entering the military forces, put in the best order possible, and in addition that daily use of the tooth-brush be made.

Excessive use of tobacco should be avoided. Other predisposing conditions to be avoided, if possible, would be, of course, exposure and debility from any cause.

Curative. Taylor and McKinstry painted the lesions daily with a solution of salvarsan (strength not given, but presumably quite concentrated). They state:

"When found to be present the peridental gingivitis should be adequately treated as well as the Vincent angina, otherwise the condition is likely to persist indefinitely and to cause repeated recurrence of the sore throat."

Bowman[11] had great success with the following: wine of ipecac, ½ ounce; glycerin, 1 dram; Fowler's solution, 3 drams—the mixture to

[11] Proc. Roy. Soc. of Med., 1916, ix, 51: and Lancet, October 6, 1917.

be either painted over the lesions or used as a mouth wash, with directions not to swallow any of it.

Emrys-Roberts (above) says that the treatment that has met with unvarying success since its adoption in the area served by his "Mobile Bacteriological Laboratory, B. E. F.," in France, consists in the local application of a lotion composed of hydrogen peroxide, 5 ounces; wine of ipecac, 3 drams; glycerin, 5 drams; water, 2 ounces.

Mercury in any form is stated to aggravate the condition, owing to its well-known injurious effect upon the gums and mucous membranes.

Scargill[12] recommends the "topical application of ordinary tincture of iodin, twice a day." Campbell and Dyas (quoted before) recommended the mouth wash used by Bowman for gingival manifestations, or Fowler's solution alone, swabbed on three or four times a day, for lesions elsewhere. If an ulcer be deep they recommend to paint it once with 10 per cent. silver nitrate solution before beginning the Fowler solution applications. In severe cases the latter recommend salvarsan intravenously or large doses of Fowler's solution internally.

Treatment usually is followed by recovery within a week in the majority of instances.

Bacteriology. *Lesions.* Smears made from lesions caused by the infection of Vincent's angina show the organisms in a form which varies with the extent of the pathological process. Thus superficial lesions tend to show few or no spirilla, while the bacillus forms are numerous and often varied in shape and size; the typical fusiform bacillus seems to be intermediate between a shorter and a more nondescript shape and the spirilla developments. These latter (the spirilla forms) are seen only in smears made from the deeper ulcerations after some destruction of tissue has occurred.

From the above considerations and the fact that the organism is known to appear as wavy threads among the cells of still living tissue into which it has penetrated,[13] it seems reasonable to conclude that the spirilla forms result from the disintegration of such infected areas. This theory is also borne out by the poor staining quality of the spirilla forms, which would be, as it is, were they old and degenerating. Furthermore, in smears from ulcers caused by the infection we may usually find spirilla linked with fusiform bacilli.

Cultivation. Morphology. In a somewhat extended experimentation with organisms from these conditions I have been able to obtain some results previously announced by others as follows:

Tunnicliff[14] grew cultures of organism in bacillus form, under anaërobic conditions; transferred plants from such anaërobic cultures and secured growth on Loeffler's solidified blood serum at room temperature; obtained filamentous growth and spirilla forms on this medium.

Noguchi[15] reported that in old cultures, bacillus forms degenerate and often develop larger spherical forms which sometimes appear attached to short forms. It seems to me that these are nothing but the

[12] British Med. Jour., October 6, 1917, p. 469.

[13] This is the case in sections taken from the edge of the still living tissue in cases of noma (see Herman, Arch. Pediat., November, 1905). Tunnicliff (quoted elsewhere) grew the Vincent's angina organism from the lesions of noma.

[14] Jour. Infect. Dis., April, 1911.

[15] Jour. Exper. Med., September, 1912.

result of involutionary vacuolization or of the processes common in spore formation (so-called). The granulation process produces forms indistinguishable from cocci.

Campbell and Dyas (quoted before) reported that they found when the organism was "grown anaërobically in ascitic broth containing a piece of tissue—after three or four weeks—a few living spirochetes, very numerous granules and numerous empty shells of spirochetes."

On culture the fusiform bacilli tend to lose their tapering appearance and the spirilla forms ordinarily do not appear. I have noticed that whenever a colony of the bacilli on solidified blood serum produces a digestion of the medium, spiral threads, without septa, are commonly produced, and the same is true of growths on fluid blood-serum media. On this latter, after two or three days' incubation (at 37.5° F.), many of the threads or strings of bacilli will be seen to terminate in a distinct spiral formation, smaller and less distinctly stained than the main portion of the thread. This appearance, when compared with the poor staining of the spiral forms in smears from the lesions and the fact that the spiral forms in the latter are frequently to be seen linked with fusiform bacilli, as previously mentioned, makes it very plain that the two forms—spirilla and fusiform bacilli—are one and the same organism. This belief is well-nigh universal among authorities.

The spiral formation is therefore evidently a degenerating non-septate strand of bacilli, curved in growth, perhaps, and curling more as it shrinks and staining but slightly.[16]

The organism grows under either aërobic or anaërobic conditions, on suitable media, but the activity of any growth varies with the strain, or rather with any peculiarities that it may show at the time experimented with. Such qualities seem to depend upon the immediate ancestry and environmental conditions which acted upon the same. Thus, I have seen a most actively growing culture which formed a thick pellicle upon serum bouillon (and had been cultivated thereon for several generations) fail to grow when a piece of the pellicle was transferred to solidified Loeffler's blood serum.

The organism from C. H., a case reported in this article, when first isolated would not liquefy Loeffler, while that from E. L. (the purpuric case) did. The Loeffler liquefying form shows Gram-positive polar bodies.

The range of temperature at which the organism grows includes "summer heat" (70° F.), so that it is evidently saprophytic.

The culture obtained from the case of E. L., grew well on excised guinea-pig tissue (spleen and kidney), forming a thick pellicle, and penetrating and liquefying the kidneys. In form it was similar to that developing on serum bouillon.

General Morphology. The bacilli, in smears from lesions and sometimes from cultures, exhibit, when stained, transverse non-staining bands which vary in number, usually with the length of the organism. Some bacilli, when short and possessing but a single band (bipolar

[16] It should be mentioned, to prevent an impression that such qualities in a bacillus would be unique or extraordinary, that even on artificial cultivation many bacilli show spirilla-like forms—for instance, the Bacillus lactis albus (an organism found in milk) produces many distinct spiral forms on nutrient agar.

bacilli), are indistinguishable from diplococci. Some of the spiral forms frequently exhibit similar markings.

The organism when degenerating develops the so-called sporulating form (vacuolization) and granules can be seen escaping from the ends.

The organism is motile, apparently possessing a single terminal flagellum. Unless showing polar bodies (granules) the organism is Gram-negative. When the granules exist they are Gram-positive.

Animal Experiment. Bouty reported (see before) that "injection of impure cultures causes a'..cesses in which the spirochete is abundant."

In a number of trials on two rabbits I failed to produce mouth lesions by the injection of serum-bouillon cultures beneath the mucous membrane. However, I succeeded in producing a small ulceration near the meatus on the penis of a rabbit. I had first injured the inside of the rabbit's foreskin by applying a hot piece of platinum foil and then applied several loops of culture. No growth took place at the site of the burn and the ulcer developed upon the opposite side of the glans.

The organisms in this ulcer were nearly entirely bacillary, but an occasional spirillum could be seen.

The Problem of the Amebic Dysentery Carrier in India and Mesopotamia.—MacAdam and Keelan (*Indian Jour. Med. Research*, July, 1917) discovered Entameba histolytica in apparently normal stools of numerous cases in the surgical division of the hospital, as well as in the medical wards, other than those assigned to dysentery. A systematic examination was then commenced and the present report is based upon the protozoölogical investigation of over 2000 men, mostly of the Mesopotamian field force, whose condition ranged from general good health to one associated with acute and chronic intestinal disturbances. Their records show that histolytica infection is so frequent that efforts at prophylaxis should be directed entirely to the purely sanitary aspect of the question. They believe that the segregation of any but the "gross" human carriers will remain an impossible and futile task until our therapeutic methods or the destruction of the cysts are more certain and effective. The results of treatment make doubtful the utility of attempting to clear men of histolytica infection while living under war conditions, or even while they continue to live in the tropics. Thus in a series of patients who gave an average of five negative examinations in hospital, after a residence of one week in the Convalescent Depôt, a single reëxamination of the feces revealed the persistence of the infective agents in one-half of the cases. This shows the futility of any scheme for the clearing of dysentery patients where the protozoölogical examinations are entirely confined to the period during which the patients are resident in hospital. Also since 17 per cent. of total number of histolytica carriers, which they detected, gave no past history of dysentery, or marked diarrhea, they question the military advisability of prolonged segregation of dysenteric convalescents, who are otherwise healthy. By comparison with the findings of Dobell (Medical Research Committee, Special Report Series No. 4, 1916) it is found that the incidence of protozoal infection is distinctly higher in the Mesopotamian troops examined while still in the tropics, than in those patients who have returned to a more temperate climate. W. H. F. A.

Diseases of the Suprarenals in Soldiers.—RAMOUD and FRANÇOIS (*Bull. Soc. Méd. Hôp.*, Paris, October 12, 1917) encountered 26 cases of disease of the suprarenals in their sector since last May. This is a higher proportion than would be found in times of peace, and it is inferred that the lowered resistance of the suprarenal is to be associated with the increased demands upon it produced by the continued mental and physical tension resulting from the war. This tension affects also other organs but especially the suprarenals which respond rapidly to various nervous stimuli, and which exercise control over the tonicity of various systems. Other authors have reported on evidences of suprarenal insufficiency as seen in cases with asthenia and psychasthenia, low blood-pressure and tachycardia and various gastric disturbances. Certain infectious diseases show more distinctly than in times of peace the mark of hyposecretion of the suprarenals such as typhoid and the paratyphoid fevers, dysentery, malaria, diphtheria, scarlatina, and diverse septicemias. Vaccinations against typhoid and paratyphoid fevers sometimes cause marked disturbances of the functional activity of the gland. It is probable also that the asthenia so pronounced in those who have been gassed originates in great part from the same cause. The authors think it is this overexhaustion of the gland which exposes it to tuberculous infection. In this series of twenty-six, the suprarenals were tuberculous in nearly all, but rarely did the patients have pulmonary tuberculosis. Only four survived. Two of these showed evidences of associated hyperactivity of the thyroid, and the authors believe that inasmuch as the thyroids can function vicariously for the suprarenals, this thyroid hypertrophy was the means of defence. This idea is elaborated in the same journal, November 29, 1917 (p. 1131), where the clinical history of one of these two patients is given in detail. The patient had been at the front for two years without wound or illness. Then he began to experience great fatigue, and in three months showed clearly all the characteristics of disease of the suprarenals. Three months later when being examined he was found also to have an hypertrophied thyroid and other signs of Basedow's disease. This was six months after the beginning of the adrenal disease, and at this time, according to the declaration of the patient the feeling of fatigue began to diminish and the cutaneous pigmentation seemed to decrease. At any rate it is certain that during the two months he was under constant observation the skin did not continue to pigment, and in general the patient looked as if he were only at the beginning of suprarenal disease, not in the fifteenth month of it. The authors deduce that suprarenal disease complicated with Basedow's disease is relatively less serious than that of suprarenal disease alone. They also found that combined suprarenal thyroid opotherapy is the medication of choice in Addison's disease, but that even with this treatment, the results were markedly favorable in only three out of twenty-two cases.

W. H. F. A.

Eye Changes in Trench Nephritis.—KIRK (*British Med. Jour.*, January 5, 1918) examined a series of between 70 and 80 cases which had come to Malta from the Macedonian front. They were chiefly young men, and on arrival nearly all were seriously ill. At that time the fundi of a number of the patients were examined, and almost invariably

there was found marked retinal congestion with large pulsating veins. Some weeks later several complained of eye symptoms, and these on examination showed definite swelling of the optic disk with patches of retinal exudation. The whole series was then examined carefully, which was about three months after the onset of the illness. In those patients who were still severely ill, showing often a large quantity of albumin in the urine and sometimes blood, definite retinal changes were more distinct than in the patients who were convalescent. In these severe cases the spots of exudation were seen in the usual situations, near the disk and in the macular area. As the nephritic condition improved the smaller patches of exudation were gradually absorbed Hemorrhages were not common, and those seen were of the small punctate variety, and not of the striate or flame-like character. The optic disk was often affected, the changes varying from a definite swelling to slight woolliness and indistinct edges. Small areas of edema were noticed especially along the course of the veins. The author suggests that the pathology is probably an acute congestion resulting from some specific toxin, that the exudation which ensues is partly lymphatic and partly cellular in nature, and that this deposit probably clears up in the great majority of cases, without leaving any permanent result. So the condition is one which is probably allied to the acute retinitis of pregnancy, scarlatina and acute uremia, and not to be confounded with the retinitis of chronic kidney inflammation with the accompanying permanent changes in the retinal circulation vessels and tissues.

W. H. F. A.

The Tuberculous Army Recruit.—GAFFIKIN (*British Jour. of Tuberculosis*, January, 1918), while serving at a rest station behind the lines, made careful chest examinations of a large number of cases sent back for various minor ailments. During a period of four months he found the complete clinical picture of pulmonary tuberculosis in 1.9 per cent. Of these cases only a small fraction, about one-fifteenth, gave a history of previous tubercular disease. The conclusion is drawn that, as all these had been picked men, passed as fit for general service, a large proportion must have developed clinically observable phthisis during their service. This directly contradicts those who assert that the outdoor life of the soldier, the abundance and excellence of army rations, the regular hours and discipline of army life might be regarded as providing an excellent set of conditions for the recruit who shows signs of pulmonary tuberculosis either latent or arrested. The factor which outweighs all these is, according to the writer, the absence of rest. There is no rest in the trenches, and even when the unit leaves the trenches there is no adequate rest. Hence the French plan is commended, that a definite history of tuberculosis, with the exception of tuberculous lymphadenitis, should be regarded as a bar to enlistment for active service.

W. H. F. A.

REVIEWS

THE SPLEEN AND ANEMIA: EXPERIMENTAL AND CLINICAL STUDIES. By RICHARD MILLS PEARCE, M.D., Sc.D., EDWARD B. KRUMBHAAR, M.D., Ph.D., and CHARLES HARRISON FRAZIER, M.D., Sc.D. Pp. 419; 16 illustrations. Philadelphia and London: J. B. Lippincott Company, 1918.

THIS volume, presenting both the experimental and clinical evidences of the relationship of the spleen to anemia, reflects accurately the present state of our knowledge of this involved problem. The material is presented in three different sections by the respective authors, and covers the experimental, clinical and surgical phases of the subject.

The first section, by Dr. Pearce, presents the experimental groundwork on which is based our present ideas of the relationship of the spleen to blood destruction and regeneration. This section embodies the detailed studies which have appeared from the Department of Research Medicine of the University of Pennsylvania during the past few years. The various theories of the relationship of the spleen to the hemopoietic system are considered. Theories rendered untenable in the light of experimental evidence are discarded and theories supported by like evidence are emphasized. The effect of experimental splenectomy on the blood picture, the hemopoietic system, and metabolism is considered in detail. Numerous control experiments are reported and the evidence carefully sifted. Nowhere are sweeping conclusions drawn. On the other hand, the author endeavors to present a careful and concise summary of the present state of knowledge on the relationship of the spleen to the problems of blood destruction and regeneration, and in this the book is notably successful.

The second section, by Dr. Krumbhaar, presents the modern views on the classification, symptomatology, pathology and therapeutics of the various non-infectious splenomegalies. Of special interest is the chapter on the effects of splenectomy in pernicious anemia. The literature on this subject has been carefully reviewed and analyzed, and the conclusions drawn from this study are both interesting and valuable.

The third section, by Dr. Frazier, deals exclusively with the surgical aspect of the problem. The modern technic of splenectomy,

which has developed as the result of the more extended use of the operation in recent years, is given in detail.

The volume as a whole should fill a long-felt need, presenting as it does all our modern knowledge of the experimental, clinical and surgical phases of this many-sided problem. The entire literature of the subject is reviewed and an exhaustive bibliography attached. The volume is ably and adequately illustrated; the plates, many in colors, of the pathological lesions in the various splenomegalies being especially excellent. To the clinician this volume should be of great value for the intelligent study and treatment of the so-called "splenic anemias." A. C. W.

IMPOTENCE AND STERILITY, WITH ABERRATIONS OF THE SEXUAL FUNCTION AND SEX-GLAND IMPLANTATION. By G. FRANK LYDSTON, M.D., D.C.L., Formerly Professor of Surgical Diseases of the Genito-urinary Organs and Syphilology in the Medical Department of the State University of Illinois. Pp. 322; 26 illustrations. Chicago: Riverton Press, 1917.

UNTIL comparatively recent years little attention was paid to the subject of aberrations of the sexual function by the reputable physician, indeed the apathy exhibited toward diseases of this type usually encouraged the sufferer to visit the quack, who accordingly became fat and prosperous. In presenting this monograph on impotence and sterility, the author has covered the subject not only from the theoretical stand-point but has gone into quite some detail concerning the experimental work that has been done by himself and others and the practical application of such work. That he is a firm believer in the practicability of sex-gland implantation is evidenced by the fact that he transplanted a testicle from a dead body into himself with results that were quite satisfactory. To the reader, the account of this experiment together with the several other interesting and successful transplants would seem to indicate that Lydston had discovered the fountain of perennial youth which Ponce de Leon failed to find.

Granting that the author is correct in his belief that the results of his experiments have conclusively proved that transplantation of sex glands even from the dead body is both practicable and successful, the reviewer is willing to be considered somewhat conservative in hesitating to accept the proposition of advising transplantation in the treatment of senile dementia, dementia precox, neurasthenia, arteriosclerosis, psoriasis, various sexual perversions and the many other widely divergent conditions as suggested by the author, who is undoubtedly carried a bit too far by the enthusiasm resulting from a few of his experiments. F. B. B.

TALKS ON OBSTETRICS. By RAE THORNTON LAVAKE, M.D., Instructor in Obstetrics and Gynecology, University of Minnesota. Pp. 151. St. Louis, Mo.: C. V. Mosby Company, 1917.

THIS little volume is presented by the author with the idea that it may supplement the text-book rather than supplant it and to this end it is written in a very interesting narrative style in the form of talks which the author has given to his students while waiting on labor cases in the out-patient department. In opposition to the usual theoretical considerations with which the average book is replete, this brochure is purely practical and presents to the student or practitioner the methods of prevention and treatment of the various obstetric complications in a manner which admits of no misunderstanding. Most of the statements are based upon the author's personal experience and are rationally conservative. Throughout the book there are two points which are continually emphasized and which prove that the author is presenting the latest knowledge on the subject; the first point is the plea of the author for the substitution of rectal for vaginal examinations in all but exceptional cases with the idea of reducing puerperal sepsis to a minimum and the second outstanding point of the book is the great stress which the author lays upon the importance of proper dental care for the parturient woman, thus reducing the various complications, perhaps including eclampsia, which result from such focal infections. On account of the numerous practical points which the book contains together with their ready accessibility, it would be an excellent idea for the student on out-patient labor cases to carry such a book in his obstetric bag. F. B. B.

KIRKES' HAND-BOOK OF PHYSIOLOGY. Revised and Rewritten. By C. W. GREENE, Professor of Physiology and Pharmacology, University of Missouri. Ninth American revision. Pp. 790; 509 illustrations. New York: William Wood & Co., 1917.

SEVENTY years of service must surely constitute a record in text-books, and it is now that period of time since Kirkes' *Physiology* first appeared. This was in 1848, just twelve years after William Sharpey, often referred to as the father of English physiology, became the first professor of physiology at University College, London, and gave there the first separate course of instruction devoted to this subject. Indeed, it might be said, that the history of this book in its various editions covers nearly the same period as that of the subject of physiology itself since its separation from anatomy. The work was originally written by William S. Kirkes, assisted by James Paget, both of St. Bartholomew's Hospital,

London. The first American edition appeared in 1849 and was published by Lea & Blanchard. Later on, in 1873, there appeared another first American edition from the eighth English, and dating from this the present volume is marked as the ninth American revision. By reason of these constant revisions the book still serves as a reliable source of present-day information for students of this branch of the medical sciences. In the present edition Professor Greene has made changes in the chapter on nutrition to call attention to the subjects of food factors necessary for growth and of vitamines and nutritional diseases, but otherwise the present volume differs but little from the preceding, and may be regarded as giving a conservative presentation of the subject.

W. H. F. A.

DISEASES OF THE SKIN. By M. B. HARTZELL, A.M., M.D., LL.D., Professor of Dermatology at the University of Pennsylvania. Pp. 753; 242 illustrations, 40 colored plates. J. B. Lippincott Company, 1917.

THIS is an extremely good book! The author has availed himself of a very large personal clinical experience in the production of this work and has given a most creditable account of his observations, and the deductions he has made from these observations. He has expressed himself in his characteristic, fearless manner and has assumed responsibility for most of the views as to etiology, pathology, and treatment of the countless diseases described in the book. Comment must be made upon the illustrations, but only in praise of their originality and accuracy in depicting the features of the diseases under discussion. The photomicrographs are especially good and understandable. The text is unusually lucid and clear for a work on this subject. The sections upon diagnosis are especially readable. Treatment is dilated upon at great length. Unfortunately there are a number of remedies recommended, the names of which do not appear in the Pharmacopœia. Doubtless these are among the "New and Unofficial Remedies," but the average reader may not know that and the suspicion may arise in his mind, after a difficult, perhaps fruitless, search for the preparation, that the work is subsidized. An appendix containing notes regarding these preparations would not be inadvisable. As in any first edition of a book of this character there are a number of minor errors of interest only to the author and publisher which will be corrected immediately, but even these in the aggregate do not detract one iota from the value of this work. The author is to be congratulated upon this production. The reviewer has no hesitancy in placing this book among the foremost books on the subject in the English language.

S. H. B.

PRACTICAL MASSAGE AND CORRECTIVE EXERCISES. By HARTVIG NISSEN, President of Posse Normal School of Gymnastics; Superintendent of Hospital Clinics in Massage and Medical Gymnastics; Formerly Lecturer and Instructor of Massage and Swedish Gymnastics at Harvard University Summer School; late Director of Physical Training at Boston and Brookline Public Schools; Former Instructor of Physical Training at Johns Hopkins University and Wellesley College, Former Director of the Swedish Health Institute, Washington, D. C.; author of Swedish Movements and Massage Treatment. Pp. 211; 68 illustrations. Philadelphia: F. A. Davis Company.

THE first chapter of this book is devoted to indications for massage, the second to eleventh inclusive explain and discuss massage and manipulation in an elementary fashion, and very briefly. The twelfth to fourteenth inclusive take up in a most elementary fashion corrective exercises. From the fifteenth to the final chapter various conditions are discussed and their treatment by massage delineated. The author enumerates the following conditions: stiffness of the joints and tendons, morbid condition of the foot in which the arch is destroyed, hysteria and hypochondria, chlorosis and anemia, insomnia, diabetes mellitus, diseases of the brain, spinal cord and nerve, anemia of the brain, locomotor ataxia, infantile paralysis, occupation neuroses, cramp of various type, chorea, sciatica, circulatory, respiratory, genito-urinary, digestive diseases, appendicitis, scoliosis, rheumatism in various localities, specifically of the joints.

Many of the ailments noted would be benefited naturally by massage, but the fact that cure or correction of many of the maladies enumerated is intimated or claimed shows (1) the lack of knowledge of the etiology and pathology of these conditions, and (2) the methods of therapeutics which must be employed in rational treatment.

The order of the book is faulty, and as a hand-book is not well arranged in ready-reference fashion. As a text-book it is too brief and elementary to be of service to the advanced student of the subject. W. J. M.

LIGATIONS AND AMPUTATIONS. By A. BROCA. Translated by ERNEST WARD, F.R.C.S. Pp. 285; 510 illustrations. New York: William Wood & Co., 1917.

THE translator tells us that he has "simply translated the book as it is written, without editing or foot notes." Broca, himself disclaims any originality and says frankly that he has drawn his material entirely from Faraboeuf, claiming that the student hardly reads the work of the latter because it is too long and the operative

procedures described are too numerous. Broca describes only one procedure for each operation, and has prepared this digest only for students who take the knife in hand for the first time. The translator remarks that little alteration has been made in these branches of surgery in the last fifty years. The illustrations are original, diagrammatic and excellent. T. T. T.

THE SURGICAL CLINICS OF CHICAGO FOR AUGUST, 1917. Pp. 207; 71 illustrations. October, 1917. Pp. 215; 84 illustrations. Philadelphia: W. B. Saunders Company, 1917.

THE high reputation of this publication, attained for it by Dr. John B. Murphy, is being maintained by the new plan of providing contributions from various noted surgeons, fifteen in the August number and sixteen in the October number. The style of presentation of the subjects varies from the brief case report to the more systematic treatment of the condition involved. Lucidity and compactness prevail and a large number of interesting conditions are discussed in a most practical manner. Because of the large number and wide variety it is difficult to particularize. Ochsner on Jacksonian epilepsy, Eisendrath on common duct calculi, Bevan on tumors of the breast, and Ridlon on hip disease deserve special mention. Shambaugh's report of a case of Ludwig's angina treated expectantly with recovery is unfortunate, since the treatment receives the credit of a cure due to the spontaneous evacuation of the pus into the mouth. This, however, is only 1 of 5 cases reported by this writer and does not impair the value of the remaining large amount of good material. T. T. T.

RADIUM THERAPY IN CANCER AT THE MEMORIAL HOSPITAL, New York (First Report, 1915–1916). By HENRY H. JANEWAY, M.D. With the Discussion of Treatment of Cancer of the Bladder and Prostate, by BENJAMIN S. BARRINGER, M.D., and an Introduction upon the Physics of Radium, by GIOACCHINO FAILLA, E.E., A.M. Pp. 242; 18 illustrations. New York: Paul B. Hoeber, 1917.

THIS is a most valuable contribution on the subject of radium therapy, and is to be conscientiously recommended to all who are interested in radium as a therapeutic agent. The authors deserve the greatest praise for presenting a report of cases in a manner that attracts the interest of the reader and gives valuable assistance not only to those taking up the work of radium therapy but also to those

who have attained skill and experience. It is beyond doubt one of the most valuable contributions on the subject published in this country. In the introductory section Mr. Failla discusses, in a concise manner, the physics of radium, with special reference to a clear understanding of its application in treatment. This section of the book is particularly free from the rather abstruse technicalities with which the physicist is pleased to deal, but which appears so often as mere words or symbols, with little meaning to the physician. In the second section Dr. Janeway discusses the methods of application to cancerous and other lesions. After a general consideration of methods and applicators a general report is made of each class of cases, with detailed case reports of representative cases. These reports are especially valuable because of the careful attention given to the description of the technic employed. The third section comprises a summary of 55 cases of carcinoma of the bladder and prostate treated by radium. H. K. P.

ON THE ALLEGED INCREASE OF CANCER. By WALTER FRANCIS WILLCOX. Reprinted from the Journal of Cancer Research, July, 1917, Vol. II, No. 3. Pp. 98.

THE author concludes that it is "probable, although far from certain, that cancer mortality is not increasing." The alleged increases are due (1) in greatest part to increased reports of inaccessible cancer (abdominal, etc.), due to improvement in diagnosis, and (2) changes in age composition of population. F. D. W.

PHYSIOLOGICAL MEDICINE. A MANUAL ON MENTAL DISEASES FOR PRACTITIONERS AND STUDENTS. By MAURICE CRAIG. Third edition. Pp. 484. Philadelphia: P. Blakiston's Son & Co., 1917.

THIS is the third edition of this excellent manual on mental diseases. In this book of less than 500 pages the subject of mental medicine is discussed very well, and altogether it is one of the best of the shorter expositions of psychiatry. It takes the older view-point of mental diseases. Besides it has 27 plates, which show the different alterations of the nervous system present in different types of mental diseases. These plates are excellent.

This book contains a new chapter on the psychoneuroses occurring in the men exposed to shell shock and strain in war. The author makes the interesting statement: "Already French observers have reported that shell-shock cases examined in field hospitals within a

very short time of the concussion exhibit symptoms which in the patient have been regarded as pathognomonic of organic disease. Such symptoms are the plantar extensor reflexes, absent knee-jerk, and absent cutaneous reflexes, etc. So far as the mental conditions arising from war are concerned, the author states that there has not been any development of any special war type. T. H. W.

AN INTRODUCTION TO THEORETICAL AND APPLIED COLLOID CHEMISTRY. By DR. WOLFGANG OSTWALD, Privatdozent in the University of Leipzig. Authorized translation from the German. By DR. MARTIN H. FISCHER, Eichberg Professor of Physiology in the University of Cincinnati. First edition. Pp. 232; 45 illustrations. New York: John Wiley & Sons, Inc., 1917.

THIS book consists of five lectures, the material for which was gleaned from a series of lectures given by the author in many of the universities in this country. The attempt is made, and successfully so, to give a general survey of modern colloid chemistry as a pure and as an applied science. Furthermore, the subject is treated in a way that makes it intelligible to the general reader.

The author believes that with radiochemistry was born a twin science, the fruits of which are no less wonderful and the application possibilities of which to all branches of science, to technology, and to industry are not only equal to but exceed those of radiochemistry. Certain it is that the importance of colloid chemistry is coming to be appreciated more and more, and this volume, the author designates a propaganda sheet for colloid chemistry.

The first three lectures deal with the fundamental properties of the colloid state, colloids as examples of dispersed systems, methods of preparing colloid solutions, classification of the colloids, physicochemical properties of the colloids and their dependence upon the degree of dispersion, and the changes in state of colloids. The fourth lecture treats of some scientific applications of colloid chemistry, and the fifth lecture deals with some technical applications of colloid chemistry.

The book is well written, easily read and mechanically leaves little to be desired.

The author might have done well to omit entirely the addendum to the preface, or at least to omit that part of the addendum in which reference is made to the "justice of my Fatherland and of its power to carry matters to a victorious conclusion." H. D.

PROGRESS
OF
MEDICAL SCIENCE

SURGERY

UNDER THE CHARGE OF

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An Anatomical Point which Facilitates the Location and Delivery of the Appendix.—GUTHRIE (*Ann. Surg.*, 1917, lxv, 742) says that the method described can only be employed in cases in which the appendix lies free in the abdomen. Through a muscle splitting, or McBurney's incision, the index and middle fingers of the left hand are inserted into the ileac fossa. The cecum, lying directly underneath, is lifted well up in the ileac fossa by a cat's-pawing action of the fingers until the head is located. The fingers are then swept along the course of the ileac vessels from without inward, describing the arc of one-fourth of a circle, until the point of attachment of the root of the mesentery is reached. This is felt as a band, which marks the location of the ileocecal juncture. The base of the appendix, if lying free in the abdomen, should be within three-fourths of an inch from this point. If the hand is now elevated slightly anteriorly and the fingers moved about, the appendix, as a rule, can be found. Grasped between the fingers it can be delivered from the wound. Should a right rectus or midline incision be used the band is located by sweeping the fingers in the opposite direction, *i. e.*, from within, outward, and upward.

Observations in Military Surgery—CLARK (*Surg., Gynec. and Obst.*, 1917, xxv, 463) says that in spite of the steel helmets, wounds of the skull are frequent. The surgeon is between the two evils of immediate meningitis if he closes the wound and cerebral hernia if he leaves it open. In the great majority of cases conservative surgery has no place in the military practice of the present war. Foreign bodies are being removed as a routine by aid of new instruments of localization. There is a tendency to remove all loose bone fragments in shattered fractures but the method lacks the support of statistics of ultimate results. Important factors in the reduction of mortality are Carrel technic in wound infections, guillotine or *coup de hache* method of amputation, routine use of antitetanic serum, oxygen injections for gas-bacillus infections. Very early in the war it was found that the shaping of the

classical flap in doing a primary amputation was a waste of time and tissue. The infection which followed invariably resulted in sloughing of the flaps which demanded a secondary operation, and in some cases a reamputation. It was found expedient to perform a rapid amputation of all tissues, skin, muscle, and bone, at the same level, what the French call *coup de hache*. Aside from ligature of vessels, nothing is done but the straight cut across, severing the part as it might be done by laying it on a block and clipping it off with a headsman's axe. In the wide-open wound thus formed the infection can be easily controlled and cleared up. In the meantime the soft parts have a tendency to contract away from the bone, and in the thigh cases this is sometimes serious, as the surgeon seeks to conserve as much tissue as possible. To overcome this contraction it is necessary to apply wide adhesive straps at four points around the stump and attach a weight of from five to ten pounds, which will hang over a pulley at the foot of the bed and maintain a constant traction against this retraction of the skin and muscle. When the granulations begin to form and the pus is all gone the plastic repair of the stump is done, including reamputation of the bone and of the nerves and the shaping and suture of the flaps.

Fascia Transplantation into Visceral Clefts.—NEUHOF (*Surg., Gynec. and Obst.*, 1917, xxiv, 383), after a study of the literature and a series of experiments on dogs, says that the free transplantation of fascia into aseptic fields has a wide sphere of usefulness. It has proved very satisfactory in the replacement of thoracic defects, of aponeurotic defects in operations for various types of hernia and of defects of the cranial dura. Fascia transplants have been very successfully used, in a variety of ways, for the reinforcement or replacement of ligaments, tendons, and paralyzed muscles. They have proved effective as coverings for wounds of solid organs, especially the liver. Their usefulness has not been clearly demonstrated in other aseptic fields; as shields for the isolation of nerves, as strips for occlusion of the pylorus, in fixation or suspension of organs, for separation of joint surfaces. There are many advantages of fascia over other tissue transplants (fats, muscle, periosteum, etc.), for the purposes mentioned. Fascia (lata) is most readily accessible and is obtainable in almost unlimited quantities; its removal does no damage. Transplanted fascia has a remarkable tendency to heal in place even under most disadvantageous conditions, requiring minimal nourishment to obviate necrosis. It combines great tensile strength, with slight tendency to stretch or contract. It is most readily adaptable to the shape of any organ, and, technically, can be most easily handled. Finally, fascia can be transplanted autoplastically. The ultimate fate of transplanted fascia has not been definitely determined. Of practical importance is the fact that the resultant firm, connective tissue is as serviceable as the original transplant. Experimentally, fascia transplants have been found satisfactory for the reinforcement of suture lines in hollow viscera. They were successfully employed in a few instances to bridge small tracheal fistulæ, and they occasionally prevented leakage from small esophageal and bladder fistulæ. These occasional satisfactory results were found to depend upon healing by contraction of the defect. For this reason failure followed every experimental effort to replace appreciable esophageal and vesical defects. The technic employed in these

experiments on hollow viscera (and on other organs) was the attachment of the transplant over the defect. To offer any chances for uniform success a method evidently was required to prevent the cut margins of the organ from rolling back, to give sutures a firmer hold on the organ by passing them through all its layers, to more readily supply the graft with provisional nourishment, and to invite the overgrowth of the lining mucous membrane of the organ. It is demonstrated in this paper that these requirements were met satisfactorily by suturing fascial sheets into instead of over defects of hollow viscera (and of other organs).

The Value of the Leukocyte Count in the Diagnosis and Prognosis of Acute Appendicitis, as Based on Experience in One Hundred Cases. —HEWITT (*Ann. Surg.*, 1917, lxvi, 143) says that the counts here submitted have all been taken from cases of appendicitis clinically acute, and in so far as he has been able to ascertain no coexistent infection has been present. All counts were taken within a few hours of operation and the great majority were taken immediately before the administration of the anesthetic. The wide variation noticeable in the counts reveals the widely variant acuteness of the infection and the effort exerted by the resisting forces of the body. The absolute count when taken alone is of questionable value. The polynuclear count alone is, in the great majority of instances, a reliable index in diagnosis. The correlated absolute and polynuclear counts are of greater value than either count taken alone, especially as regards prognosis. A high absolute count with a high polynuclear count means usually a good prognosis (*e. g.*, absolute 35,000, polynuclear 95 per cent.). A high absolute count with a moderately low polynuclear (*e. g.*, absolute 30,000, polynuclear 80 per cent.) means usually a very good prognosis. A low absolute count with a high polynuclear count (*e. g.*, absolute 7000 with polynuclear 95 per cent.) indicates a grave prognosis (speaking generally). A low absolute count with a low polynuclear count (*e. g.*, absolute 7000 with polynuclear 65 per cent.) usually means no infection, or that the acute condition is due to anatomical or mechanical causes; in other words, that the infection, if one be present, has not stimulated the resisting powers of the body sufficiently to produce a leukocytosis. Normal or subnormal figures do not necessarily indicate the absence of suppuration, gangrene, or their sequels. Catarrhal cases, fulminating cases, moribund cases, and walled-off abscesses frequently do not stimulate leukocytosis.

Retention of Ovarian Tissue after Hysterectomy. —GRAVES (*Surg., Gynec. and Obst.*, 1917, xxv, 315) says that specific surgical menopause symptoms consist chiefly of vasomotor disturbances in the form of hot flushes. Theoretically, vasomotor changes of the artificial menopause are due to a break in the uteroövarian functional harmony by which the physiological balance of the glands of internal secretion is upset with consequent disfunctional activity. After extirpation of the uterus, vasomotor disturbances ensue, with approximately equal frequency, whether the ovaries be retained *in situ*, totally ablated, or transplanted. Retention of ovarian tissue after hysterectomy is of little or no physiological value, and may be of serious harm to the patient.

OBSTETRICS

UNDER THE CHARGE OF

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Puerperal Septicemia Treated by Autogenous Vaccine, with Recovery.—GEIER (*British Med. Jour.*, September 30, 1916) reports the case of a woman who had a twin labor, the first child delivered in breech presentation and the second in vertex. There was a slight tear of the perineum. The patient continued well until the afternoon of the eighth day, when she felt hot and flushed. On the following morning she complained of pain behind the left shoulder. She became nauseated and vomited freely. The temperature was 101° F., and the pulse 100. The lochia was not foul and there was an abdominal tenderness. The secretion of milk was abundant. She had superficial inflammation of the gums associated with carious teeth. The patient complained of rheumatic pain in the left shoulder and over the left elbow. On the seventh day the temperature rose to 104° F., pulse 120 to 130, the secretion of milk had ceased, and there was severe pain and tenderness. The temperature continued high, and the patient had severe chills chiefly at night. She complained of pain in the right groin. The inguinal glands were swollen, enlarged, and were associated with a pustular eruption on the pubis. On the ninth and eleventh days of her illness she was given 20 to 25 c.c. of antistreptococcic serum, and on the thirteenth day 25,000,000 streptococcic vaccine, made from a fatal case of puerperal septicemia, were injected. An autogenous vaccine from the patient's own blood was prepared, the culture being a pure growth of a short-chained diplostreptococcus. Of this, 25,000,000 organisms were injected on the sixteenth day of her illness, and on the eighteenth day 50,000,000. Every third day after this she was given 50,000,000 until near the end of her illness, when she had 75,000,000. She had a well-marked, fine, discrete, papular rash resembling scarlatina, appearing first on the face, neck, chest, and upper extremities, and on the following day on the lower portion of the body. The eruption did not itch and desquamation occurred after the eruption had disappeared. This was followed by a fall in temperature, and then a rise from a pus formation over the right shoulder. After this had been opened the temperature gradually fell to normal. The writer is inclined to believe that the case was one of scarlet fever developing during the puerperal period.

Puerperal Gangrene of the Extremities.—STEIN (*Surg., Gynec. and Obst.*, October, 1916) reports 2 cases of puerperal gangrene of the extremities. The first was a young, vigorous primipara who, shortly after admission to the hospital, aborted at three months. There was a foul odor from the fetus as well as from the vagina. Following this there was some rise in temperature, which dropped again to normal. This was followed by another rise to 104° and 105° F., for the next six days, with no pain and no other symptoms. On the seventh day it

was decided to curette the uterus, and on examination there were numerous grayish-white, superficial ulcers around the cervix, covered with whitish membrane. The curette brought away a small portion of placental tissue. After curetting the interior of the uterus and cervix were thoroughly swabbed with tincture of iodin. This was repeated for the next seven days. Seven days after the curetting the patient complained of pain in her right leg, and ten days after curetting the right leg and foot began to swell, became cold, and showed violet-bluish discolorations. The pulsation of the dorsalis pedis artery was not felt and the foot was very painful. Deep sensation gradually disappeared. The Wassermann test was negative. The whole foot ultimately became gangrenous, the swelling extended $2\frac{1}{2}$ to 3 inches above the ankle, where a line of demarcation could be seen. Amputation had finally to be performed below the knee. The patient made a good recovery and left the hospital in good condition. The heart had always been normal and several blood cultures showed no growth, especially no hemolytic streptococcus were found. On microscopic examination the characteristic lesions of gangrene were present, with thrombosis of the peroneal artery, venous thrombosis, and necrosis of the skin, fascia and muscle. His second case was a forceps delivery at full term in a primipara who was in good condition and in whom the Wassermann examination was negative. She was delivered with medium application of forceps, and a second degree laceration was repaired with chromic catut suture. Two days after confinement the patient had a temperature of 104.5° F., and a chill. Slight ulcers were found about the cervix, which were treated by iodin applications and douches. The urine showed a trace of albumin and hyaline casts. On the sixth day after confinement the sutures in the perineum were removed because the whole area was sloughing. Ten days after labor the patient had an irregular temperature, rising to 103° and 104° F., and, on the eleventh day, to 105° F. On the twelfth day after confinement the patient left the hospital against the advice of the physician, but returned seven days later in a critical condition. Both feet for about four inches above the ankle were discolored, nearly black, and the skin shrivelled. The feet were extremely tender when touched, cold, and in some places showed vesicles filled with whitish fluid. The line of demarcation was well pronounced about four inches above the ankles. There was no pulsation in the femoral arteries. The patient died about one month after delivery from extreme exhaustion and debility. Several cultures made from the blood showed there was general septicemic infection. An autopsy could not be obtained. The writer has collected 76 cases, whose reports seem authentic, of which 63 were cases of puerperal gangrene following labor with one personal observation, the author's second case; and 4 cases after abortion with a personal observation, the author's first case; 4 cases occurred in the late course of pregnancy and 5 cases after gynecological operations, which had been added for reasons of completeness. These cases are gangrene, due to the puerperal state and affecting the extremities. This condition may rise from puerperal thrombosis or embolism, which occurs in 1 in 500 births and 1 embolism in 9000 births. A considerable loss of blood predisposes to this condition and so does an abnormal constitution of the blood. Although the veins of the genital apparatus are often diseased during pregnancy, peripheral puerperal gangrene of

venous origin is very rare. Although phlegmasia alba dolens is not uncommon, it rarely, if ever, terminates in gangrene. The arterial origin of peripheral puerperal gangrene is far more common and is probably always due to infection. The rise of temperature commonly seen in thrombosis after childbirth is undoubtedly due to infection. One can readily understand how such thrombosis can occur should the blood become infected through bacteria lodged at the placental site. The development of gangrene will depend largely upon the question as to whether the collateral circulation after thrombosis can be maintained. When both veins and arteries are blocked the condition is that of arteriovenous puerperal gangrene. It may be difficult, if not impossible, to decide that a given case is of this variety, because it is impossible to differentiate between primary and secondary thrombi. The most usual cause of this condition is puerperal pyemia resulting in septic endocarditis, with involvement of the valves of the heart from which infected emboli are carried into the circulation. The mechanical conditions after childbirth are all favorable to the development of such complications. The symptoms of incipient gangrene naturally vary with the origin and path of the infection. Pain is severe and never absent in extensive vascular obliteration, such as lead to peripheral gangrene. The ordinary symptoms of puerperal fever usually develop, but there are signs of tissue necrosis. Septic puerperal endocarditis, as a rule, is present. Sometimes the gangrenous symptoms will suggest the cause and seat of the obstruction in the circulation. When the attack begins suddenly the indications are that embolism in the arterial system has developed, but when gangrene makes itself known very gradually the obstruction is in the venous circulation. In a general way it may be said that the early appearance of gangrene in the first few days after childbirth indicates its arterial origin. The manifestations usually seen in gangrene are severe pain, absence of arterial pulsation below the thrombus or embolus, and sensibility is diminished while motility may be preserved. A livid discoloration and relatively diminished temperature in the affected area indicate incipient gangrene. In cases of venous origin it may be possible by examination through the vagina or rectum to palpate the inflamed veins in the broad ligament. Sometimes dry and moist gangrene are combined in the same case, depending upon the rapidity of the complete interruption of the blood current and the presence of external factors which favor mummification. The pain is usually better when gangrene has become established, but the patient's general health suffers. Death may occur before demarcation is established, with increased pulse and temperature. The prognosis depends upon the patient's condition. If she is sufficiently strong to bear amputation her chance for recovery is greatly improved. It is not always practicable, because of the patient's bad condition or the rapid progress of the gangrene, or because the seat of the obstruction is located high up in the aorta. From one-half to two-thirds of these patients die. The mortality has been lessened about half by modern methods of treatment. The treatment consists in purely conservative measures, such as elevating the affected limb, giving stimulation to the heart, transfusion, and similar measures. The line of demarcation is the signal for surgical interference. Although the dangerous symptoms may apparently subside it is best to remove the gangrenous part as promptly

as possible. Prophylaxis consists in the best of hygienic, aseptic, and antiseptic management of deliveries, the improvement of the local circulatory conditions through elevation and gentle massage, and the aseptic and antiseptic management of lesions of the skin. The majority of the cases suffered from peripheral gangrene of the lower extremities. After abortion, gangrene of the lower extremities must be comparatively rare, as but 3 cases have been collected. Gangrene of the upper extremities in the puerperal period is also rare.

GYNECOLOGY

UNDER THE CHARGE OF
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Bacteriological Study of the Endometrium.—Some of the most interesting and at the same time most useful studies that have been elaborated by an American gynecologist in recent years have been those of Curtis, whose past work along the line of leucorrhea and other endometrial disturbances are probably familiar to all. It is fitting therefore to call attention to the latest presentation of this worker, which consists of a combined bacteriological and histological study of the endometrium in health and in disease (*Surg., Gynec.* and *Obst.*, 1918, xxvi, 178). The work is based on observations made upon a series of 118 cases. It was Curtis's object to make a study of the endometrium, exclusive of the cervix, in all conditions usually encountered except those associated with pregnancy. All of the material used was secured from uteri removed at operation. Scrapings from the endometrium are so liable to contamination that cultures from them are not included in this series. The technic that was employed in securing the material for this study consisted in cauterizing the stump of the cervix and the entire length of the peritoneal surface of the uterus and then bisecting the anterior wall. With sterile instruments the greater part of the endometrium is excised in its entire thickness down to the muscle layer, and is placed in sterile containers to be ground and cultured. The remainder serves for immediate examination and for microscopic study. The reason for undertaking such a study as this is because Curtis believes that it is especially desirable to compare histological evidences of chronic inflammation of the endometrium with cultures from the same material. Though we are interested in the frequency with which the endometrium yields histological signs of endometritis, after all a problem of more vital clinical importance is whether bacteria live in those tissues which are altered. We wish to learn whether the presence of mononuclear cells in a given piece of tissue means a possible focal infection of the uterus, and we need to know whether such a uterine cavity can be handled with impunity at operation or must be considered a zone of danger from which infection may spread. In the classification of cases studied it has

seemed best to distinguish between nulliparous and parous patients. Among the latter pregnancy has introduced the possibility of fundus contamination and has also rendered the cervical canal relatively more patent for the ascent of germs into the uterus. Each of these two groups has again been divided into those in which the history has been normal and those with history or operative evidence of pelvic infection. Group 1. The endometrium of nullipara without history of infection. Of 26 supposedly non-infected nulliparous cases, cultures and tissues were normal in 23. Streptococci were isolated from 1 case, while in 2 other cases, which had been curetted respectively eight and six days before hysterectomy, mixed growth appeared in the cultures and the histological evidences of endometritis were present. Group 2. The endometrium of nullipara with history of gross evidence of pelvic infection. Of the 13 patients in this class 12 yielded no growth. Histologically 9 of these were normal, 1 showed tuberculosis, 1 a slight cellular infiltration and 1 was invaded by polynuclear and plasma cells. The endometrium of a case with recurrent infection of sixteen years' duration yielded gonococci in cultures and histological evidence of chronic endometritis. Group 3. The endometrium of parous women without history or gross evidence of pelvic infection: Of the 47 women in this class, in only 2 cases did the endometrium show growth. One of these patients, with intra-uterine manipulation preliminary to operation, yielded a moderate number of colonies in mixed culture and was microscopically normal. The other, a victim of persistent uterine hemorrhage, showed anaërobic streptococcus infection and microscopic evidence of endometritis. Group 4. The endometrium of parous patients with history or gross evidence of pelvic infection. Of the 32 patients belonging in this class 9 showed a growth in the culture of the endometrium; 4 of these, regularly exposed to reinfection, yielded gonococci and showed histological subacute endometritis. Another without exposure for six months had inflammation of the endometrium and Fallopian tube with gonococci from both. Two cases of many years' standing yielded respectively a diplococcus and a streptococcus. Ten endometria without growth proved microscopically normal, 2 contained round cells, 1 a postmenstrual polynuclear increase, 7 had plasma and round cells and 3 revealed distinct histological endometritis. As a result of these extensive investigations, Curtis has come to the conclusion that, pyometra and recent exploration of the uterus excepted, the endometrium almost never shows bacteria except when there is infection of adjacent pelvic tissues. Chronic endometritis *per se* with bacteria present in smears or cultures is practically to be ruled out as a clinical entity. Several points of clinical importance come up in this work. In the first place we may consider infection of the endometrium consequent to curettage. In certain cases normal scrapings have been obtained from the uterus; then, several days thereafter, in the endometrium secured by hysterectomy mixed cultures and endometritis have been found. Infection is perhaps not a customary result of curettage, but it appears not uncommon. This calls attention to the fact that preparation for instrumentation of the uterine cavity does not ordinarily include cleansing of the cervical canal, yet this tissue is freely accessible to all vaginal flora. Curtis believes, therefore, that it is a wise precaution to gently introduce an iodin applicator as far into the cervix

as it is patulous before attempting to pass instruments. In regard to the problem of intra-uterine therapy, it has been found that chronic infection of the corpus uteri speaks for almost certain involvement of other pelvic organs. Intra-uterine applications are therefore of little avail, for the most important focus of infection is well beyond their reach. Again, in the absence of bacteria it may be desired to rid the patient of a persistent discharge. Study of this question makes it appear that mucus secreted from the body of the uterus is in very small amount and limited mostly to the premenstrual period. In the cervix are glands, prolific in activity, especially adapted to mucous secretion. It is here, in the cervix, up to the level of the internal os, that we will do best to look for infection, and it is against discharge from the cervix that treatment can be efficiently directed.

OPHTHALMOLOGY

UNDER THE CHARGE OF

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Physiological Tension of the Eyeball.—In an extensive study of this subject running through three numbers of the *Ann. d'Oculistique*, May, 1917, p. 272; June, p. 334; July, p. 385) MAGITOT sums up as follows: The normal tension of the eyeball oscillates between 15 and 25 mm. Hg.; it may vary between these limits from day to day and even during the same day. It is apparently lower in the aged than in the young. The tension corresponds to variations of the general arterial pressure, though the globe possesses an autoregulating mechanism which serves to oppose increase of pressure. The factors capable of influencing the ocular tension are: (*a*) the general circulation, (*b*) the local circulation, (*c*) the structure of the walls of the globe itself. The latter is extensible in the adult to a certain degree, owing to the numerous elastic fibers of the sclera. The variations of the tension within normal limits are due principally to the variations of the general arterial pressure, a relationship which may be compared to that of the pulse and the temperature. But the intra-ocular tension responds to a far greater degree to variations in the local circulation than to those of the general. Among nervous influences the cervical sympathetic or its ganglia is alone capable of influencing the tension of the globe, and not the trigeminal. Section of the cervical sympathetic or superior cervical ganglion produces slight *hypertonia;* excitation determines a *hypotonia* in all animals. The sympathetic centers capable of modifying the ocular tension are three in number: (*a*) the bulbomedullary

centers (primary centers) possess an action particularly dilating; (*b*) the cervical and cephalic centers (secondary centers) possess an action particularly constricting; the action of the ocular center (*c*), tertiary center, is variable. Of these centers the role of the ocular is the most important; it is the true regulating organ. The aqueous humor has no influence upon the ocular tension. Collyria have little influence. The slight effect which they exert depends upon their action upon the diameter of the uveal vessels. Finally, the tension of the globe is solely under the influence of the greater or less repletion of the ocular vessels. These vessels are themselves governed by the vasomotor nerves. But the capital importance which the sympathetic ocular center (tertiary center) plays in the innervation cannot be too much insisted upon.

Acute Infectious Retrobulbar Optic Neuritis.—LENOIR (*Ann. d'Oculistique*, July, 1917, p. 411) argues that this condition possesses a special symptomatology which differentiates it sharply from other diseases of the optic tract. The functional disturbances consist of rapid and frequently great diminution of the visual acuity, with deep periorbital pains, increased by pressure upon the globe and extreme excursions of the same. The ophthalmoscopic appearances are ordinarily slight or absent, simply at times some infiltration of the optic disk. There is an absolute central scotoma, and more rarely, irregular contraction at the periphery. The affection develops rapidly in the course of a few weeks, and generally heals without notable visual impairment in spite of the atrophic appearance of the disk. Alternating, relapsing and binocular cases occur, but in the latter the two eyes are always affected successively and the evolution of the lesions presents no symmetrical character. The disease is frequently complicated by more or less severe disturbances of the nervous system, which may simulate intracranial hypertension, but of which the prognosis is favorable. The cause cannot be attributed to sclerosis *en plaques* nor to syphilitic or rheumatic infection, but presents all the marks of an infectious lesion. Frequently consecutive to mild infections of the rhinopharynx it seems in certain cases to be dependent upon lesions of the sinuses, particularly the sphenoidal. Whatever be the origin the inflammation of the sheath of the optic nerve causes compression of the nervous elements, of the macular bundle in particular and lesions of degeneration whose gravity is in direct ratio to the duration and intensity of the inflammatory process.

Ocular Signs of Death.—TERSON (*Arch. d'Ophtal.*, May–June, 1917, p. 513) describes the early and late ocular signs of death. The reaction of the pupils was found to be variable. They responded slowly to light, as also to atropin and physostigmin for several hours after death; electricity sometimes contracted the pupil five or six hours after death. Cauterization, scraping, sulphate of copper and subconjunctival saline injections produced no redness in the still warm body two hours after supposed death. Instillations of ether may cause damage; the reporter prefers dionin, which is followed by no reaction if applied two hours after death. These reactions may lead to important results in early cases of apparent death when other signs are still wanting.

Sympathetic Uveitis.—MORAX (*Ann. d'Oculistique*, July, 1917, p. 426) shows that sympathetic infection may have, as its point of departure, traumatic lesions both of the anterior and posterior segments of the globe; the former are much the more common. Anatomopathological studies of the sympathizing eye present uniformity of choroidal lesions, characterized essentially by a nodular or diffuse thickening of the choroid from penetration of lymphocytes between the uveal layers. The writer holds that all microbiological researches (direct examination, cultures, inoculation) have given a negative result and that the idea of microbic infection must be abandoned in this disease. Anatomical researches have convinced him, as they have others, that the uveal inflammation shows identical lesions which constitute a characteristic picture. He believes that the introduction of a new technic or modification of those already known will hereafter disclose the active agent of this infection.

Ocular Affections in Pest.—YOUDINE (*Wiestnik Ophtal.*, t. xxvii, 21) has examined 19 eyes of 15 individuals dead of pest; 16 were enucleated two or three hours and 3 ten to thirteen hours after death. The lesions discovered were localized principally in the posterior segment, in the chorioretina. The author believes that iridocyclitis, serous iritis and non-suppurative kerato-iritis result from the propagation of the inflammatory process of the uveal tract. The lesions observed are as follows: The veins and capillaries of the choroid are widely dilated, especially marked in the posterior portions of the choroid near the optic disk; in the neighborhood of the ciliary body the dilatation is less. In some of the eyes the dilated vessel was seen in the section to fill up almost the entire thickness of the choroid. The vessel walls are thinned, the endothelium swollen. In some cases the wall was necrotic, the degenerated tissue being sometimes swollen and sometimes granular. In one case which lasted thirty-four days there was hyalin degeneration of the walls of the small vessels. The layers of the choroid contiguous to the retina were fitted with an exudate consisting of a structureless mass, filaments of fibrin, globules of hyalin and pigmented granulations; the same exudate also penetrated between the choroid and the retina. The latter membrane was thickened and its vessels gorged with blood; the vessel walls were distended with liquid, the perivascular spaces dilated. The nuclei of the endothelium were swollen at some points so as to project into the lumen of the vessel. The ganglion cells were slightly pigmented. The cells of the internal and external granular layers were swollen and showed a lack of chromatin. In the internal nuclear layer cystoid degeneration had taken place. In all the eyes examined the retina was more or less detached from the above-mentioned exudate between the choroid and retina. Bacteriological examination was negative in every case as regards the bacilli of bubonic plague. This negative result favors the opinion that the ocular lesions were due to toxins of the bacilli.

Ocular Manifestations of Icterohemorrhagic Spirochetosis.—WEEKERS and FIRKET (*Arch. d'Ophtal.*, September–October, 1917, p. 647) show that this infection gives rise to frequent and diverse ocular manifestations; these are icterus of the conjunctiva, simple hyperemia

of the anterior segment of the eyeball, congestion of the iris, iritis, optic neuritis, retrobulbar neuritis, ocular herpes and subconjunctival hemorrhages. Hyperemia of the anterior segment, congestion of the iris and iritis are all probably phenomena due to a variable degree to a localization in the highly vascular uveal tract of the spirochete circulating in the blood just as it becomes fixed in the hepatic and renal tissue. These alterations in the uvea are generally benign; they may even recover spontaneously and easily yield to appropriate treatment. Optic neuritis and retrobulbar neuritis, likewise benign, are probably related to the presence of the spirochete in the cephalorachidian fluid and in the liquid which bathes the sheaths of the optic nerves. Ocular herpes is rare; it may give rise to lesions of the globe itself, particularly of the cornea, and thus cause permanent damage to the sight. Icterus of the conjunctiva and subconjunctival hemorrhage are of no special significance as regards the eye.

DERMATOLOGY

UNDER THE CHARGE OF

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Intravenous Foreign Protein in the Treatment of Psoriasis.—SCULLY (*Jour. Am. Med. Assn.*, November 17, 1917) reports favorable results in psoriasis from the injection of a foreign protein, the protein employed being a typhoid vaccine containing 100,000,000 organisms to each cubic centimeter. From three to five injections were given at intervals of three or four days, and following the third injection a 2 per cent. chrysarobin ointment was used on the body and a 5 per cent. ammoniated mercury ointment on the scalp and face. His conclusions are as follows: Intravenous vaccines alone do not clear up the lesions of psoriasis, though they do lessen the induration and inflammatory reaction. When used in conjunction with chrysarobin ointment the lesions clear up rapidly. Favorable results were obtained in chronic generalized cases resistant to other forms of treatment. Chrysarobin dermatitis is prevented by the vaccine, and when present yields promptly. (We must confess to a very decided skepticism as to the real value of these injections; it is to be kept in mind that the eruption of psoriasis frequently diminishes or even disappears for a time without any treatment.—M. B. H.)

Treatment of Frost-bite.—CAMESCASSES (*Le Bull. Med.*, January 26, 1918) highly recommends the following mixture in the treatment of frost-bite: Picric acid, 0.25; alcohol, glycerin, āā 10. This is painted over the affected parts twice a day, allowed to dry and should not be wiped off. After the second application the itching, pain, redness and swelling disappear. When ulcers are present, these are treated with zinc oxide paste.

Results Obtained by Heiser's Treatment of Leprosy in Nigeria.—COGHILL (*Ann. Trop. Med. and Parasit.*, August 23, 1917) used the mixture recommended by Heiser, viz., 60 c.c. chaulmoogra oil, 60 c.c. camphorated oil and 4 grains of resorcin. Of this mixture, which was sterilized by boiling, 2 c.c. were injected into the buttocks as an initial dose and the dose was increased 1 c.c. per week until 8 c.c. were being given at intervals of a week. As this dose, however, produced some discomfort it was reduced to 6 c.c. twice a week, which was well tolerated. Every case responded to the treatment. The most obvious effect was the healing of ulcers, many of which were extensive and had lasted for many years. Softening and absorption of the nodules, fading of macules and return of sensation were also noted, not only by the author but by the patients themselves. As this treatment was begun only in 1916, he believes it too early to decide whether it is actually curative.

Treatment of Scabies by Sulphur Fumigation.—BRUCE (*British Jour. Dermat.*, April–June, 1917) finds fumigation with sulphur a rapid and certain method of treating this most annoying affection, which is extremely prevalent at this time in the armies of the Allies. The treatment is carried out in the following manner: The patient is first given a thorough bath with soap and hot water, the skin being well scrubbed to open the burrows. He is then placed in a cabinet, somewhat like a Turkish bath cabinet, seated upon a chair, with the head protruding through an opening in the top, and a warm, wet towel around the neck to prevent the escape of the vapor. A sulphur candle is then placed in the cabinet and lighted. After forty to fifty minutes the patient is quickly removed from the cabinet, and he puts on warm, clean clothing. The infected clothing and bedclothing may also be disinfected at the same time. It is important that the cabinet shall be warm and contain water vapor. In the majority of mild cases a single treatment is sufficient, the author having had but 2 per cent. of returns among 200 cases thus treated, and these he believed to be due to reinfection with insufficiently disinfected clothing. In the discussion which followed the reading of the paper, however, Major MacCormac called attention to the fact that the method was an old one which Hebra had tried and given up. MacCormac had found nothing superior to the old treatment, with sulphur ointment applied for three days after a preliminary hot bath.

Urticaria with Malaria.—GARIN and PASQUIER (*Lyon méd.*, November, 1917) call attention to the great frequency with which urticaria occurs in connection with malaria. More than 30 per cent. of 135 patients under their care in the hospital for malaria at Modane suffered from recurring attacks of urticaria, and in almost every case the appearance of the urticaria was preceded by diarrhea. Jaundice of malarial origin was also frequently accompanied by urticaria, the association of these symptoms indicating a severe malarial infection.

Acanthosis Nigricans following Decapsulation of the Kidneys.—WISE (*Jour. Cutan. Dis.*, January, 1918) reports a case of this rare malady following decapsulation of the kidneys done for mercurial

poisoning. The patient was a young woman who a year before had taken, with suicidal intent, a solution supposed to contain 7.5 grains of mercuric chloride. She was promptly treated and apparently made a complete recovery, but on the advice of friends, six days later submitted to decapsulation of the kidneys at the hands of another medical advisor. About nine months later she developed a severe dermatitis with intractable pruritus, which was followed by more or less general pigmentation of the skin, with masses of brown to black closely aggregated warty excrescences in the groins and axillæ; lichenification of the greater portion of the skin and moderate hyperkeratosis of the palms and soles were also present. The author believes the cutaneous disease to have been induced by some disturbance or impairment of function in the abdominal cavity brought about by the operation upon the kidneys.

Late Urticaria Pigmentosa.—HARTZELL (*Jour. Cutan. Dis.*, November, 1917) reports two cases of urticaria pigmentosa beginning the one at twenty-three years of age, the other at nineteen, and calls attention to the increasing number of cases of this affection reported as beginning at or after puberty. Although the affection still remains practically a disease of infancy and early childhood it is probably much less infrequent in adults than has hitherto been supposed. Graham Little in a series of 142 cases collected from the literature and his own observations found no less than 14 per cent. beginning at or after puberty. While these late or delayed cases correspond in their symptoms in the main with the early ones, they also, in a considerable number of cases, have exhibited more or less marked departures from the typical cases. The adult cases have rarely shown lesions of the xanthelasmoid type. Attention is likewise called to the often insignificant role played by urticaria in the symptomatology and the consequent inappropriateness of the name by which the affection is known.

Focal Infection in the Etiology of Skin Disease.—CHIPMAN (*Jour. of Cutan. Dis.*, October, 1917), in a paper read at the Forty-first Annual Meeting of the American Dermatological Association, arranges the dermatoses possibly due to focal infection in six groups: (1) Those related in some way with joint affections, such as erythema nodosum, erythema multiforme, gouty eczema, psoriasis; (2) those which apparently were more or less neuropathic in character, such as lichen planus, lichen simplex (Vidal), herpes simplex, herpes zoster, neurotic eczema, alopecia areata, dermatitis herpetiformis, scleroderma, vitiligo; (3) those related to tuberculosis as erythema induratum, lupus erythematosus, lupus vulgaris, lichen scrofulosorum, various tuberculides; (4) those arising from a focus in the skin itself, as impetigo contagiosa, infectious eczematoid dermatitis, various streptococcic infections; (5) those having some relation to anaphylaxis, as eczema, urticaria, erythema multiforme, angioneurotic edema; (6) miscellaneous affections, such as rosacea, granuloma annulare, chilblains, Raynaud's disease. In a study of 50 consecutive cases of diseases belonging to these groups a very large proportion (49) showed infection of the teeth either alone or in connection with infection of the tonsils.

PATHOLOGY AND BACTERIOLOGY

UNDER THE CHARGE OF

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An Investigation of the Cultural Reactions of Certain Anaërobes Found in Wounds.—The confusion in our knowledge of the anaërobic bacteria is reflected in the literature, the expanding nomenclature and the divided opinions on the importance of the various strains isolated from wounds. The investigation of HENRY (*Jour. Path. and Bact.*, 1917, xx, 344) has resulted in a definite clarification of the subject and will undoubtedly serve as a stimulus to further work along the same general lines. The fundamental importance of pure cultures in such a study and some practical methods for isolation of the more important anaërobes found in wounds are well brought out. The method of isolation makes use of the author's modified M'Leod plate, attention being given to the special media and the careful technic found necessary, colony differentiation being practical after a little experience. Detailed descriptions of the more important anaërobes are given and methods of identification are clearly presented. The first and most frequently encountered is that of the B. welchii known under various names, viz., B. aërogenes capsulatus, B. perifringens (frequently used in the French and English literature), B. phlegmonis emphysematosæ of Fraenkel and a number of others. A subgroup, the B. amylobacter of Gruber and Bredmann, characterized by stormy fermentation of milk, in common with the B. welchii, and differing by its motility and the development of spores in milk, has not been found by the author in war wounds. The second group in point of frequency is the B. sporogenes (Metchnikoff). The name replaces B. edematous maligni of Koch so long in use for this active proteolytic group of anaërobes and since the term malignant edema may indicate a clinical but certainly not a bacteriological entity, it is very much better to use the simpler name. In this group should also be included the B. putrificus (Bienstock) and the B. cadaveris sporogenes of Klein. The vibrio septique of Pasteur, so often included in the group by earlier writers, is not placed here by the author, but rather in the saccharolytic group. The name B. tertius is that chosen by the author for the oval end spore-bearing saccharolytic bacillus which has been found as the third most frequent anaërobe of wounds. The other names used by various writers for this organism are Bacillus ix von Hibler, Rodella iii and Bacillus Y of Fleming. The author also includes in his study a number of anaërobes isolated and described by Weinberg and Seguin, viz., B. fallax, B. aërofetidus, B. edematiens and B. histolyticus. The fermentation reactions on a large number of carbohydrates is important and the author confirms the results of Simonds in the subdividing of B. welchii. In his discussion of the changes produced by anaërobes in the tissues the author points out the various conditions brought about in the wounds in modern

warfare, unavoidable, the soiling of the wound by earth or by clothing infected with fecal organism, the use of the short-range bullet and shrapnel shell, with the resulting extensive tissue damage. The anaërobes develop in damaged tissue just as they do in artificial cultures. The carbohydrate fermenters or saccharolytic group are the first to develop. The damaged muscle because of its carbohydrate content (about 1 per cent.) forms a favorable nidus for this growth. The glycogen of the living muscle is converted after death into dextrose and a small fraction of isomaltose, both of which are vigorously fermented by B. welchii. The author considers that the low sugar content in skin and subcutaneous tissue does not favor this development in wounds limited to these regions. The production of acid and gas results from this fermentation. The gas may appear clinically in four to six hours after the receipt of the wound and helps to embarrass the circulation. The organic acids bring about as one of the reactive changes an absorption of water by the protoplasmic colloids, and this combines with the exudate in the areolar spaces to form the edema so often seen in aërobic infections. This edema may spread far beyond the confines of the bacterial invasion. A second reactive change to the acid results in the appearance of autolytic enzymes both saccharolytic and proteolytic. The result of these various factors is a devitalization of the tissues. This early saccharolytic phase is followed in the wound, as in the test tube, by the proteolytic phase when the more slowly growing proteolytic group becomes established. The penetrating fetid odor so striking clinically in anaërobically infected wounds as well as the blackening of the tissue are both indications of the active presence of this second group. A third phase of toxemia and the last stage of anaërobic growth, the successful invasion of the blood, are rather briefly discussed. This article merits the careful attention of everyone interested in the bacteriology of war wounds. The illustrations are especially noteworthy.

Loss of Power to Produce Sarcomatous Transformation in the Stroma of Carcinoma.—Woglom (*Jour. Cancer Research*, 1917, ii, 471) premises that certain changes which have been found in the stroma of carcinomata are sarcomatous. This is not a constant possession of the carcinoma cell, for the Flexner-Jobling tumor lost this power between the fifth and eleventh generations. Similar findings have been reported in four other tumors. The neoplasm described by the author was found in the left inguinal mamma of a female mouse of unknown age on March 17, 1914. The sarcomatous transformation of its stroma was lost after the fourth generation, and this power has not been regained up to the twenty-first generation. It recurred in one mouse in each of the first, second and fourth generations and in two mice of the third. The percentage of successful inoculations varied from zero to one hundred, and the growth was fairly rapid and usually continuous. The tumor type was an adenocarcinoma; alveolar areas were often encountered and keratinization was frequent. The stroma was not especially cellular. In the sarcomatous areas the characteristic halos of lightly stained cells encircling the cancer cells were seen. The author raises the interesting question "whether mouse tumors containing keratin may not, perhaps, induce sarcomatous development in their stroma more often than other types of carcinoma."

Complement-fixation in Experimental Trypanosomiasis.—It has been shown by a number of authors that the serum of animals infected with trypanosomes will give specific complement-binding with antigens prepared from the homologous trypanosomes or with certain organs of infected animals. Woods and Morris (*Jour. Infect. Dis.*, 1918, xxii, 43) studied complement-fixation with T. equiperdum with a view of determining the time of occurrence, the relation of the symptoms, its specificity and its relation to the Wassermann reaction, and to the effect of salvarsan. The antigen was prepared from the spleen tissue of infected rats. All of such antigens were not satisfactory because of the anticomplementary reactions. It was found that this antigen was as satisfactory as that prepared from the emulsion of the micro-organisms. Seven healthy dogs giving negative reactions with these antigens were infected with trypanosomes. The fixation reaction appeared in about eight days. The trypanosomes appeared in the blood before the reaction became positive. In only one animal did a positive fixation test precede the appearance of the trypanosomes. The fixation appeared to be specific. As the trypanosomes multiplied in the blood stream the sera of the dogs became anticomplementary. A variable and inconstant fixation of complement with the Wassermann antigen was also obtained. It was difficult to follow the effects of arsenobenzol treatment upon the fixation test because of the anticomplementary reaction. In one dog, however, treatment not only removed the trypanosome infection but also dissipated the anticomplementary and complement-fixation properties of the serum. The authors were able to demonstrate that by the addition of disintegrated trypanosomes to normal dog serum a moderate anticomplementary serum was produced.

Experimental Trypanosomiasis: T. Equiperdum Infection in the Dog.—Krumbhaar (*Jour. Infect. Dis.*, 1918, xxii, 34) in seeking for an agent to induce a slow destruction of the blood made use of the trypanosome which causes dourine in horses. This parasite he found was transmissible to dogs, inducing in them a fatal infection which, aside from his studies on blood destruction and regeneration, was of great interest. When once infected the blood of the dog readily transmitted the disease to new animals when given intravenously. There was an incubation period from three to eight days. With the appearance of the trypanosomes in the blood the animal showed weakness, loss of weight and progressive anemia. An irregularly disposed edema was not uncommon. Occasionally, also, eye lesions, such as keratitis, iritis and hemorrhages, were observed in the severe cases. Only twice were the manifestations suggestive of cerebral damage. With the appearance of the trypanosomes, signs of anemia manifest themselves both in the reduction of the hemoglobin and red cell count. The former may fall to 40 or lower while the latter is reduced to less than 3,000,000. A primary leukocytosis is followed by a leukopenia. Splenectomy was of no value in withstanding the infection. The author found that arsenobenzol was valuable in removing the infection and in bringing rapid improvement in the condition of the animal. They have found, however, that to ensure a permanent cure it is necessary to give three injections on successive days and to follow this with three or more injections at three-day intervals.

HYGIENE AND PUBLIC HEALTH

UNDER THE CHARGE OF

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The Etiology of Epidemic Poliomyelitis.—E. C. ROSENOW, E. B. TOWNE, and G. W. WHEELER (*Jour. Am. Med. Assn.*, October 21, 1916, lxvii, No. 17) felt that a reinvestigation of the bacteriology of poliomyelitis by newer methods was desirable since Rosenow has shown by the use of special methods that the specific localizing power of bacteria is an important factor in the etiology of various diseases including those of the nervous system, and since Flexner and Noguchi found that the cultural conditions of the organisms with which they produced poliomyelitis in monkeys are "those that apply more particularly to the bacteria." A peculiar polymorphous streptococcus has been isolated often in large numbers from the throat, the tonsils, and from abscesses in the tonsils in a large number of cases of epidemic poliomyelitis. It has been obtained from the blood before and after death, from the brain and cord, and also from the intervertebral ganglia and lymph nodes in cases of this disease. The organism isolated produces on aërobic blood plates fine, dry, non-adherent, slightly green colonies, showing in forty-eight hours a narrow, hazy zone of hemolysis. On this medium and ascites-dextrose agar, the organisms are quite uniform in size but in ascites-dextrose broth, the organisms show polymorphous forms and in ascites-plain broth they are only about two-thirds the size. Old cultures show clumps of very small coccus forms. In a very few instances the early smears showed the tiny globoid bodies described by Flexner and Noguchi as present from cultures from tissues in poliomyelitis, but they also showed a number of medium-sized diplococci in chains which tend to grow smaller, so that at the end of twelve or fourteen days nothing but the tiny globoid bodies could be found. Transplants from these to another medium showed a marked tendency of the microörganisms to change their form according to the medium on which they were planted. Cultures of Berkefeld N. filtrate of emulsions of brain and cord of rabbits dead from paralysis following intravenous injection with suspensions of broth cultures of the large forms have grown into the characteristic polymorphous forms. In the liquid medium, during the early days of growth, chains are found which contain single members of all sizes and shapes. Paralysis with lesions in the central nervous system has been produced in guinea-pigs, rabbits, dogs, cats and monkeys by intravenous or intracerebral injection with this peculiar streptococcus in its large form from practically all of 52 cases of acute poliomyelitis. The incubation period in these animals was usually from three to five days.

The early paralysis were usually accompanied by evidence of pain in the affected extremity and the affected animals were apt to die within twenty-four hours of the onset. At necropsy the paralyzed animals showed hemorrhage and lesions in the brain and spinal cord, but noteworthy absence of these in other organs. In animals in which paralysis occurred early and which died soon after large injections, the large forms have only thus far been found, while in those which died after a long period of incubation, both large and small forms have been demonstrated. The same organism has been isolated from the brain and cord of paralyzed monkeys injected intracerebrally with fresh human virus of poliomyelitis. The authors state in conclusion "that the exact relation of our results to the facts already established as to the etiology of poliomyelitis cannot be definitely stated. It appears to us that the small filterable organism which has been generally accepted as the cause of poliomyelitis may be the form which this streptococcus tends to take under anaërobic conditions in the central nervous system and in suitable culture mediums, while the larger and more typically streptococcic forms which investigators have considered contaminations may be the identical organism grown larger under suitable conditions."

The Use of Insecticides against Lice.—Bacot (*Brit. Med. Jour.*, September 30, 1916, No. 2909) made an attempt, in performing these experiments, to arrange the conditions on as nearly natural a basis as was possible. In order to test the relative effects of contact and diffusion of several insecticides, an apparatus was designed consisting of wire gauze frames which could each be covered by a small gauze bag; each constituted a series of five small cages so arranged that they could be tied against the skin. In the central chamber was placed a 1-inch square of thick lint saturated with the substance to be tested, and lice were placed in all five of the chambers. Several gauze bags containing no insecticides were included as controls, which were placed between the others to ensure no interference of the substances tested with each other's action. These tests were usually of eight to twelve hours' duration. The substances tested were naphthalene, sulphur, cresylic acid, iodoform, vermigelli, a prepared insecticide, combinations of this with phenol and cresylic acid, a mixture of vaseline, naphthalene, kerosene and benzole and cytisine, an alkaloid having physiological properties similar to those of nicotin. The net results of these tests show that the diffusive effects of all the substances except possibly naphthalene is so slight as to reduce them all to contact remedies. Therefore, it is necessary to saturate or thoroughly dust underclothing with them to obtain any effect. If naphthalene is used in some form in which the garments can be impregnated with it, it is a very good insecticide and the chief objection which can be offered to it is the fact that it evaporates very rapidly. Tests were also made to investigate the effectiveness of remedies in preventing breeding when used to impregnate clothing. Flannel was saturated with the various remedies listed above, and the lice placed in contact with it for several hours in order that eggs might be laid and developed. In these tests an emulsion of soft soap and crude liquid carbolic acid was also used. This last was found to be the best remedy for impregnating clothing to prevent the spread of lice. Flannel was treated with the various remedies and, after two days, insects were placed in contact with it and the results noted.

In these tests also the emulsion of soft soap and carbolic was found to be the most effective, the practical effect of impregnation with it lasting about six or seven days and the smell have a slight effect for several days longer. Therefore a very practical insecticide for preventing the spread of lice among troops is an emulsion of 45 to 50 per cent. soft soap combined by heating with 50 to 55 per cent. crude carbolic. A 5 per cent. solution of the emulsion in warm water should be used to impregnate the garments, which should then be wrung and thoroughly dried before wearing.

Spontaneous Amebic Dysentery in Monkeys.—EICHORN and GALLAGHER (*Jour. Inf. Diseases*, September, 1916, xix, No. 3) describe a spontaneous outbreak of a disease in monkeys in which the lesions and protozoal organisms corresponded closely to those found in amebic dysentery in man. There is no record of any similar case, and there may be a possibility of transmission of the amebas to human beings and of animals being carriers of the parasites without showing any clinical evidence. In this outbreak 8 animals out of a total of 15 exposed succumbed, and of 9 developing symptoms only 1 recovered. These animals were spider monkeys, received at the National Zoölogical Park at different times from Central America. One of the monkeys was ill when it arrived, showing symptoms similar to those later manifested by the others. This animal died a month after arrival and in three months 8 of the other animals died of dysentery. The ameboid forms were especially numerous in liver abscesses but were also found in intestinal matter. They possessed motility for from twenty-four to thirty-six hours after the death of the animal in the liver specimens and then showed a tendency to assume a circular form, became more granular and smaller in size and appeared to be encysting. An attempt was made to transmit the disease to cats since it is generally understood that they are susceptible to Ameba histolytica but it was not successful, the cats remaining perfectly well. These experiments suggest that the parasite found is of a different species from that in man and is specific for the spider monkey. The cecum and colon were invariably the seat of pathogenic changes, the rectum being involved to a greater or less degree, and abscess of the liver was associated with the 2 cases showing the most extensive intestinal lesions. A study of the histological changes in the intestine showed ulceration of the mucosa but the other layers of the intestines were not greatly affected except in areas of deep ulceration. Microörganisms other than amebas were for the most part absent, as were the types of leukocytes usually present in microbic infections, and there was no pronounced congestion. In the liver tissue there were many necrotic foci varying in size and surrounded by amebas, and there was some congestion.

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ARMY MEDICAL CORPS EXAMINATIONS

The Surgeon General of the Army announces that preliminary examinations for the appointment of first lieutenants in the Medical Corps, U. S. Army, are being held at numerous points throughout the United States, on the first Monday of each month.

Full information concerning the examination may be procured upon application to the "Surgeon General, U. S. Army, Washington, D. C." The essential requirements to securing an invitation to report for examination are that the applicant shall be a citizen of the United States, between 22 and 32 years of age, a graduate of a medical school legally authorized to confer the degree of Doctor of Medicine, of good moral character and habits, and shall have had at least one year's post-graduate hospital interneship.

The Government cannot pay to applicants any portion of their expenses incurred in connection with their examination, and due consideration, therefore, will be given to localities from which applications are received, in order to lessen such expenses as much as possible.

Chemistry and Physics have been eliminated as subjects of the examination.

Those applicants who successfully pass the examination are commissioned first lieutenants in the Medical Reserve Corps, and sent to either the Army Medical School in Washington, or to a training camp for a course of instruction, covering a period of approximately three months, during which time they draw the pay and allowances of their grade. If, at the close of their instruction, they pass the final examination, and are favorably recommended, they are commissioned first lieutenants in the Medical Corps of the Regular Army.

The Medical Corps consists of commissioned officers in number approximately equal to seven for every one thousand of the total enlisted strength of the Regular Army authorized from time to time by law, proportionally distributed among the grades and in the ratios as follows: Colonels, 3.16 per cent.; lieutenant colonels, 5.42 per cent.; majors, 23.7 per cent.; captains and first lieutenants, 67.72 per cent.

Promotion to the grades of major, lieutenant colonel, and colonel is by seniority, subject to examination.

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Officers of the Medical Corps are entitled to the privilege of retirement after 40 years' service, or at any time for disability incurred in the line of duty. On attaining the age of 64, they are placed on the retired list by operation of law. Retired officers receive three-fourths of the pay of their grade (salary and increase) at the time of retirement.

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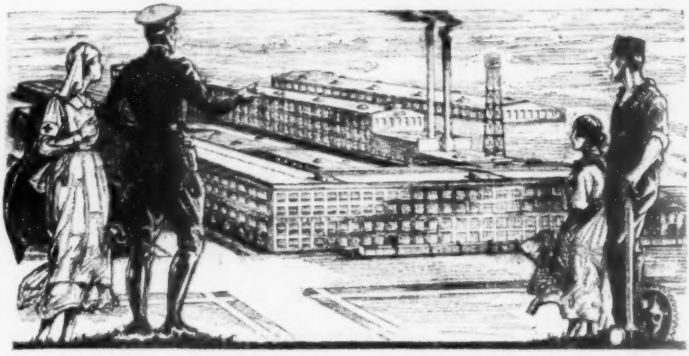

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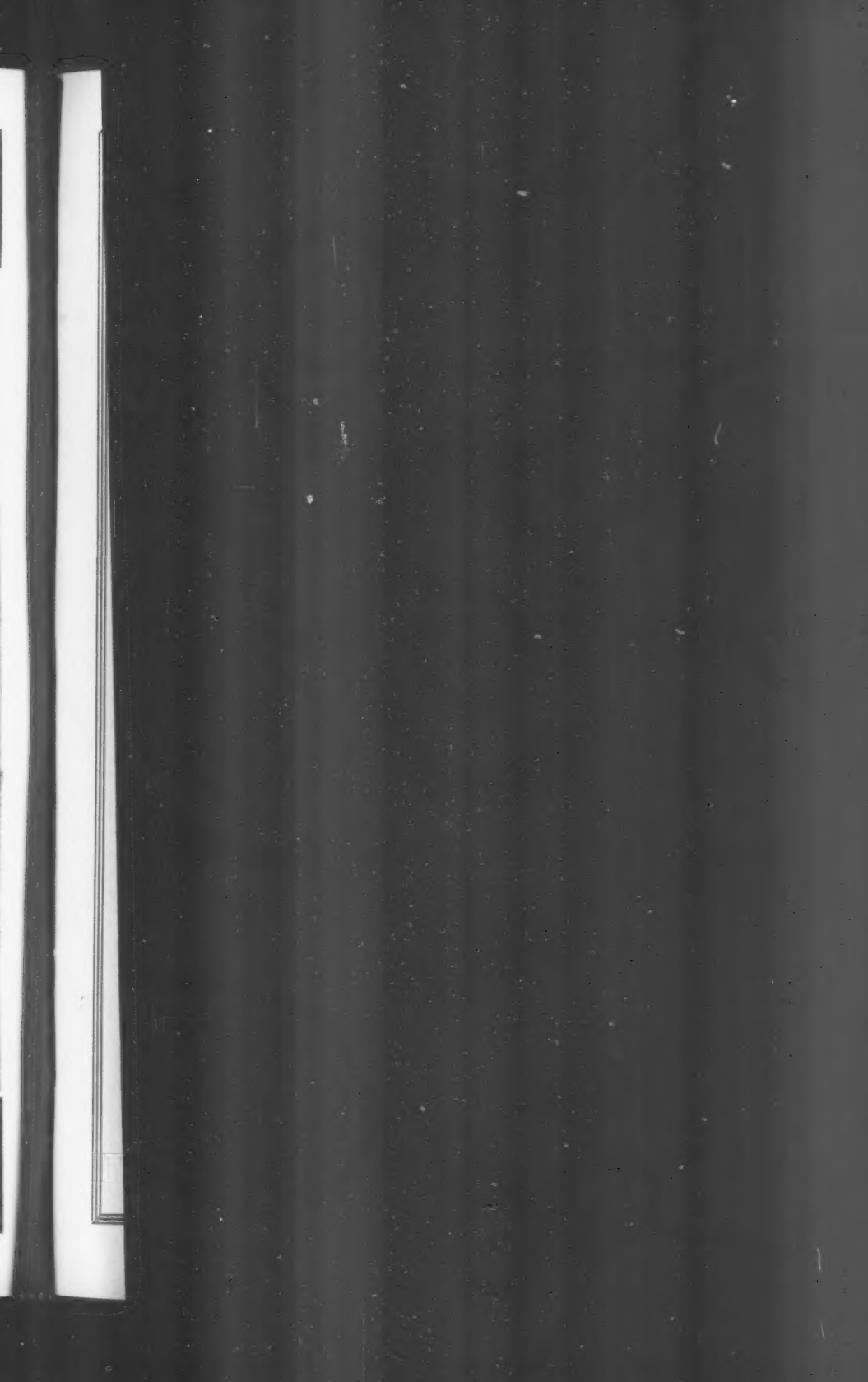

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Percentage Index to Formulas
Protein Fat Carb. Pour
1.25 1.00 4.50 16
1.25 1.75 4.50 30
1.50 .25 5.50 36
1.50 1.00 5.50 23
1.75 1.50 5.00 17
1.75 2.00 5.00 31
2.00 .50 6.25 32
2.00 1.50 6.00 24
2.00 1.75 5.50 18
2.00 2.50 5.50 32
2.25 .50 6.50 33
2.25 1.75 6.50 25
2.50 .50 7.00 37
2.50 2.00 7.00 26
2.50 2.25 6.00 19
2.50 3.00 6.00 33
2.75 2.50 6.75 20
2.75 2.50 7.75 27
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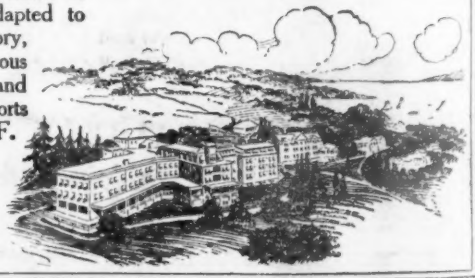

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